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TRAINING AND RECRUITMENT FOR PUBLIC SERVICES

ALTHOUGH the appointment of Lord Woolton as Minister of Reconstruction is evidence of the importance which the Government now attaches to post-war reconstruction, it has raised afresh the whole question of the machinery of government. Just as in the four years 1914–18, the stress of war has brought to light the weaknesses of the peace-time machinery of government in Great Britain. Deficiencies at the policy-forming level, where the current purposes and objectives of government are thought out and harmonized, converted into definite policies, made administratively viable and translated into practical plans and directions for those who have to execute them, have been clearly revealed, and have sometimes formed the subject of constructive criticism, notably from the Select Committee on National Expenditure. Equally conspicuous have been the defects in the machinery for finding facts, for co-ordinating available knowledge and facts, and for drawing significant inferences from them.

The proposals for the reform of the Foreign Service laid before Parliament by Mr. Eden some time ago*, which have been so warmly welcomed, may undoubtedly be regarded as an attempt to remedy some of the defects from which Great Britain has suffered in the last two decades in one branch of government, in so far as the determination, co-ordination and interpretation of facts are concerned. It does not, of course, except indirectly, affect the policy-forming level in that field, which, as was emphasized by Mr. Law in presenting the proposals to the House of Commons, is not the responsibility of the Foreign Service, but of the Cabinet and ultimately of Parliament. That aspect of the question was well analysed by Political and Economic Planning (P E P) in Broadsheet No. 201, on "British Foreign Policy", issued a year ago. More recently, in Broadsheet No. 213, on "The Future of Foreign Publicity", P E P has returned to the information and fact-finding aspects, and detailed some further suggestions for implementing the foreign policy laid down by the Cabinet.

While the discussions at present proceeding about Government and industry and the maintenance of controls have equally tended to direct attention to the machinery of government, it cannot be said that fundamental questions have been explored quite so thoroughly. Certain suggestions have been advanced, for example, in the Nuffield College Statement "Employment Policy and Organization of Industry After the War" ; but on the other hand, while the question of the Civil Service itself has been thoroughly examined in a number of reports, even where the larger question of machinery of government is faced, as in the report of the Sub-Committee of the Liberal Party on Civil Service Reform, comment rarely goes further than the submission that the whole structure of government from Cabinet level downwards requires authoritative discussion. The reconsideration of the

*Cmd. 6420. (London : H.M. Stationery Office.) 2d. net.

present functions and machinery in the light of the principles laid down in the Haldane Report finds an increasing volume of support; what is required is not so much fresh inquiry as fundamental thinking on the application of the principles laid down in that report to the problems of government to-day.

Some such analysis was attempted by Political and Economic Planning in a broadsheet on the machinery of government which appeared in July 1941. That broadsheet was concerned with the adequacy of the Civil Service and with the reforms required to make it an effective instrument of government; its proposals found strong support in a subsequent report from the Select Committee on National Expenditure in the 1941–42 session, which may well take its place with the Haldane Report as a State paper of first-class importance. No less fundamental are the observations on the machinery of government in the fourteenth report of the Committee in the 1942–43 session. Political and Economic Planning has now carried its analysis a stage further in Broadsheet No. 214, on "A Civil General Staff", devoted particularly to the machinery required to facilitate the organization and co-ordination of national policies and their execution at a level intermediate between the Cabinet as a whole and the individual Minister.

This is the main problem which Lord Woolton has to face. Whereas at the Ministry of Food Lord Woolton's task was largely that of administering a defined and simple policy, with the advantage not only of a very competent higher staff but also that the field had been very thoroughly prepared before the War, the Ministry of Reconstruction is not primarily administrative. Lord Woolton's task is not to take the decisions himself, but to see that the right decisions of policy are taken without delay. It will require the statesman's vision to see problems in the dimensions of history, and the politician's art in getting things done. From Lord Woolton the task will demand boldness as well as vision; from the small but influential staff, on the model of that of the Ministry of Defence, rather than of the ordinary ministry, it calls for clear thinking.

However gifted a statesman Lord Woolton may prove to be, success in his present post will depend largely on how far the whole Government machine is attuned to meet the demands which the post-war period, as well as the transition from war to peace, will make upon it. Some attempt must be made to deal with the fact-finding machinery and with that for co-ordinating and timing policy so as to eliminate the more glaring defects. Some improvements have, in fact, recently been suggested in the memorandum on official statistics issued by the Council of the Royal Statistical Society (see NATURE, January 15, p. 88), which urges that the statistical units of Government departments should in future be staffed by trained men, the departmental units co-ordinated and the Central Statistical Office continued and developed. This important technical contribution to the improvement of the machinery of government is supported by the observations in the sixteenth report for the session 1942–43 of the Select Committee on National Expenditure, which lead to the recommendation that the provision of the full and informative records showing the extent and variety of State assets which the Government must have at its command to make decisions on policy concerning the disposal of such assets in post-war reconstruction, and the collection, classification and co-ordination of departmental inventories should be undertaken by some central agency.

These are matters of detail which may eliminate some of the creaking and facilitate the smooth running of the Government machine. They will not in themselves—though not entirely minor matters—obviate the need for creative thinking about the functions and organization of departments and their inter-relations so as to serve more effectively the needs of to-day. The main divisions suggested in the Haldane Report are not necessarily those which will best fit the post-war need; war-time needs have provided experience of the possibilities of regrouping ministries, and even introducing new ones, which at least require exploring. A Ministry of Industry, including the industrial branches of the Board of Trade and some sections of the Ministry of Production, leaving the Board of Trade to be concerned essentially with international problems, is one suggestion that has been advanced, while clearly the functions of the ministries concerned with housing and health require thinking out afresh in terms of the post-war pattern.

Whatever form such re-organization may take, its ultimate success will depend on the men and women who will be called upon to administer policy and execute decisions. It is almost universally admitted that this will involve the recruitment of new kinds of Civil servants. So far as the Foreign Service is concerned, that is implicit in the White Paper proposals and was stressed in the subsequent debate. More generally, it is required not because the Civil Service is inefficient or incompetent, but because the present Civil servants are brought up too narrowly to discharge expertly and with understanding the many new duties of control and oversight which have been forced by events upon the modern State.

That might fairly be described as the burden of the criticism in the House of Commons debate, and both the merging of the Foreign Office, the Consular, the Commercial Diplomatic and the Diplomatic Services into one Foreign Service and the measures proposed for widening the recruitment and training for the Foreign Service are designed to remove this acknowledged defect. Criticism of the proposal to supplement the preliminary competitive entrance examination by a method based mainly on selection, as voiced in the debate, was essentially constructive, though the examination system found staunch defenders, subject to special entry for exceptional and outstanding men only. Similarly, the proposed scheme of training in which the competitive examination is taken in two parts, the second following a period of training abroad, with subsequent training of the successful candidates for a year in Great Britain, partly in the Foreign Office and partly in getting a grounding in economic, commercial and social questions, was also very fairly considered with

the view of obtaining as representative recruitment as possible from all sections of society.

The importance of the general outlook and strata of the nation finding faithful reflexion in the Foreign Service, in order that the Service may be abreast of the current life and activities of the country and represent it abroad, was universally admitted, as well as the necessity of ensuring that the Service possesses the necessary qualities of personality and character as well as of intellect. It is the fusion of politics and economics in foreign affairs so strongly emphasized in a recent report of the Select Committee on National Expenditure to which Mr. Law referred, which has made it so much more difficult for the Foreign Service, as previously recruited, to fulfil adequately its double function: that of advising the Government and giving the Cabinet a background of information about foreign countries; and that of representing the Government and the country abroad, trying to execute the policy upon which the Cabinet is determined in those countries, and promoting British interests, of which international peace and understanding are the most important, within the limits set out by the Cabinet.

Mr. Law's speech did something to put criticism of the Foreign Office in its right perspective, but even those who paid tribute to the present system recognized that there have been occasions in recent years in which its information service appears to have been defective. Much that was said, however, on such matters in this debate was almost as relevant to the Civil Service as a whole as to what it is now proposed to constitute as a wholly independent Foreign Service. The Civil Service cannot be expected to function with full efficiency unless it is sufficiently representative and in touch with the temper and outlook of the whole nation.

Conversely, it must be remembered that the spirit and efficiency of the Civil Service, including the Foreign Service, reflect the temper and interest of the community it serves and from which it is drawn. No machinery will provide us with a Civil Service of the highest ability and integrity, imbued with vision, initiative and enthusiasm, unless the mutual understanding and respect between the Service and the community whose interests it serves and safeguards are such as to encourage recruits of the requisite standard to enter the Service. No matter what training is given to recruits after entry, the merits and defects of the educational system of the country as a whole are bound to affect the tone and standard of its public services.

Recognition of this truth has led the British Association Committee on Post-War University Education to give special consideration to education for the public services. A report on that subject has now been issued, in which are considered the relations between universities and government administration, including the question of graduate schools for future or existing Civil servants, combining university work with practical experience in government offices. Using the terms 'government administration' and 'Civil Service' in the broadest sense to cover the local government service, the colonial service, the public utility corporations and services involving international co-operation as well as the home and foreign branches of the Civil Service proper, the education of those intending to enter such services or indeed corresponding careers in large-scale enterprise is related to that of university studies in general discussed in the first interim report of the Committee. The necessity of adapting the curriculum to present-day needs and conditions, and the increasing danger to higher education involved in the growth of over-specialization in many branches of knowledge apply with as much force to those intending to enter any branch of the public services as to any other type of university student. Apart from this, it is urged that any broad discipline can be made to meet the needs of intending Civil servants, provided it is taught in such a way as to train students both to generalize from given data and to question or verify against experience the processes of their reasoning.

There are three distinct aspects of the problem: first, education before entry into the senior branch of service; second, provision for higher officials to renew contact with the university during their official life; and, third, opportunities for education of a higher type for officials of lower rank as a stimulus and as a means of attaining promotion. In regard to the first, the report makes some pertinent comments in regard to those intending to enter any of the careers which involve regular co-operation with foreigners, whether in the diplomatic services, in such work as that of the British Council, in official or unofficial international organizations, in business or in journalism. It is essential for those entering upon any form of foreign service to overcome our notorious embarrassment or inhibition in our relations with those whose background, outlook and language differ from our own.

The British Association Committee considers that there is scope for a form of education designed to facilitate the process of international co-operation, and the experience of the Geneva School of International Studies over the fifteen years 1924–39, is cited to show that this can be done with success in a carefully designed six weeks' course for a body of students not too large to form a single social unit. In such a school there is a double process of cross-fertilization between intellectual disciplines as well as between national outlooks, and this also is important. Some specialization is inevitable in the foreign services. Its proportion may well be diminished somewhat by Mr. Eden's reforms, but the number of specialists engaged may well be increased. Scientific workers, for example, will probably figure more prominently than hitherto in some aspects of international co-operation, as the experience of the War clearly shows; and they too should welcome the demonstration that there is a technique for at least facilitating international co-operation and acquiring the appropriate attitude of mind.

With regard to the second aspect of the problem, this report takes up the suggestion put forward by Mr. H. E. Dale in his book "The Higher Civil Service" of a period of long leave within a few years after entering the Service. This, it is suggested, would

usually be most profitably spent in attending an advanced course in social studies, especially in the atmosphere and surroundings of a college undertaking research as well as teaching. Further, most of the future members of the higher Civil Service should spend the six winter months of a sabbatical year, before the end of the first ten years of official life, in following one of these courses in a civil service college at a university, and devote the six summer months of this year to acquiring inside knowledge of the working of one or more foreign civil services or of the international secretariat of the League of Nations.

To provide for the third aspect of the problem, the Committee recommends the institution of courses of similar duration for members of the lower branches of the Civil Service. These would be designed to provide the substance of a university education for Civil servants of proved ability who have hitherto been denied one, and to open new avenues for their promotion; and the results of the examination at the end of the course would influence the prospects of the candidate. In this way it might well prove possible to tap fresh sources of ability which would enrich the public service out of all proportion to the difficulties and expense involved in working out the plan.

This report of the British Association Committee is supplemented by a memorandum on "American Education for the Public Services" by Mr. Willard Connely, which lays welcome stress on the importance of ethnographical study in international relations. While the report shows that there is still some confusion of opinion as to the functions and purpose of a staff college, it should stimulate further discussion on this important question of training and recruitment for the public services, and help to place it in a fitting perspective in the programme of educational reform to which the Government is now committed. That programme itself should help to throw up recruits of the requisite ability and character from ever-widening circles of society, and at the same time promote the harmonious and sympathetic relations between the official and those he serves, upon which as well as upon the training and integrity of the Civil servant himself the full efficiency of public administration always depends.

SCIENTIFIC ETHICAL PRINCIPLES

Evolutionary Ethics

By Prof. Julian S. Huxley. (The Romanes Lecture delivered in the Sheldonian Theatre, 11 June 1943.) Pp. 84. (London: Oxford University Press, 1943.) 2*s*. net.

A FEW weeks ago, at a session of the B.B.C. Brains Trust (at which Prof. Julian Huxley was not present), the opinion of the members was asked on a suitable ethical basis for modern thought and action. One member spoke up for orthodox Christianity, but, from the rest, there was complete silence. Much the same reaction would probably be obtained from any half-dozen people selected at random from the Western Democracies. Prof. Huxley, in his Romanes Lecture on "Evolutionary Ethics", sets out to fill this partial vacuum with an exposition of ethical principles and practice based on the scientific approach to life and its problems and, in particular, on the facts of evolution.

Ethics has three distinct, though interrelated, aspects, which may be epitomized in three questions: How do we come to make moral judgments at all? What reason, if any, have we for thinking that one judgment is right and another wrong? On what specific moral judgments ought we, in practice, to base our actions? The first is concerned with the developmental 'natural history' of ethics, the second with what Waddington has recently called "the age-long endeavour to find an intellectual basis for ethical judgements", and the third with practical or didactic ethics.

On the first question, Prof. Huxley expands the thesis, put forward earlier in his "Uniqueness of Man", of the evolutionary significance of the development in the human infant of what he calls the "proto-ethical mechanism". He accepts, broadly, the Freudian view that ethical judgments are a product of the child's conflict between its feelings of love for its mother as the provider of comfort and satisfaction, and its feelings of hate and aggression for that same mother as the authority which, frequently and necessarily, denies to the child the enjoyment of the comfort and satisfaction for which it longs. This conflict takes the form of 'all or nothing' alternations of love and hate, which persist, at varying levels of consciousness, into adult life, and, becoming transferred to such "objects" as sin, virtue, native land or racial group, constitute the raw material of adult ethical judgments. From an evolutionary point of view, why should such a mechanism, involving the complete suppression, at a given moment, of one or other of the opposing emotions, have been developed? Prof. Huxley interprets it as a device for securing "action rather than indecision in the face of conflict", and, as such, it clearly has survival value in the struggle for existence. In addition, however, the mechanism, by attaching a load of guilt to one of the conflicting impulses, weights the scales between them, and has the effect of securing one particular kind of action rather than another. In one of the many memorable phrases in his lecture, Prof. Huxley thus sums up the situation: "Primitive love conquers primitive hate by saddling it with the burden of primal guilt; and with this the polarity of right and wrong becomes attached to our thoughts and actions".

The child, then, enters on its passage to maturity equipped with this primitive and absolutist ethical mechanism, and the main problem confronting it is to adjust this mechanism to the facts of external reality by incorporating experience with the aid of reason.

The degree to which the mechanism does, in fact, become adjusted to reality varies enormously. In any society there are a number of individuals bearing a heavy burden of unrealistic guilt, while the ethical standards of all human groups are themselves more or less unrealistic. Nevertheless, in favourable circumstances, human beings *are* able to develop without such "overdoses of untruth and unreality in their moral system", and it is in the growth of an outlook preserving a balance between the emotional driving force of our infantile proto-ethics on one hand, and the guiding influence of ordered experience on the other, that Prof. Huxley sees the hope of ethical progress in the future.

This, very briefly, is Prof. Huxley's account of the 'natural history' of ethical judgment, and the mention

of ethical progress leads to the second question referred to above, the search for an objective criterion of ethical rightness and wrongness—a search which Wittgenstein once described as "a terrible business—just terrible! You can at best stammer when you talk of it."

For the solution of this "terrible business" Prof. Huxley looks to the concept of evolutionary progress, and the corner-stone of his thesis is that our ethical standards are not static but constantly evolving. "Our ethics," he says, "evolve because they are themselves part of the evolutionary process. And any standards of rightness or wrongness must in some way be related to the movement of that process through time." He goes on to define evolutionary progress as "the capacity to attain a higher degree of organization without closing the door to further advance", and points out that, with the advent, on the evolutionary stage, of human speech and conceptual thought, it became possible, for the first time, for one of the products of the evolutionary process, namely man, to take a conscious part in it and to inject into the hitherto blind and automatic mechanism the concept of moral purpose. This marriage of evolution and morals gives rise to three main principles of evolutionary ethics, namely, "that it is right to realize ever new possibilities in evolution, notably those which are valued for their own sake; that it is right both to respect human individuality and to encourage its fullest development; that it is right to construct a mechanism for further social evolution which shall satisfy these prior conditions as fully, efficiently, and as rapidly as possible". Prof. Huxley then goes on to show how these broad principles can be applied to a number of current and recurrent ethical and social questions.

This picture of moral purpose as part and parcel of evolutionary progress, and the programme of social change derived from it, will undoubtedly provide a stimulating inspiration to progressive thinkers at the present time, but one is left with the question whether Wittgenstein's "terrible business"—an objective intellectual basis for ethics—has, in fact, been satisfactorily settled. Prof. Huxley lays great stress on the development of emotional experiences which have "inherent value" or which "are valued for their own sake", and such experiences form, in effect, the core of his theory of ethics, as indeed they must of any naturalistic ethical theory. Is the criterion of the value of these experiences an intellectual one? Surely, on final analysis, we must agree with Hume, that the assessment of such values is fundamentally dependent on the *emotional feelings* of individuals or groups of individuals, feelings of which we can approve or disapprove, the origin of which we can trace, but for which, from their very nature, we cannot find any intellectual justification. Is not Wittgenstein's "business" so "terrible" precisely because there does not exist any intellectual basis even to stammer about?

To take this view does not, however, detract from the great value of Prof. Huxley's essay as a synthesis of the scientific and ethical approaches to human problems. If moral truths are banners which inspire the emotions, rather than statements which satisfy the intellect, the Romanes Lecture for 1943 must be reckoned as a notable standard for rallying the forces at present struggling to find a basis for ethics in harmony with scientific thought and untinged with the tenets of revelationary religion.

J. S. L. GILMOUR.

TECHNIQUE OF BLOOD-GROUPING

The Determination of Blood Groups

Medical Research Council War Memorandum No. 9. Pp. 28. (London: H.M. Stationery Office, 1943.) 4*d*. net.

IT is doubtless true that on the great majority of occasions blood-grouping can be carried out correctly in a high proportion of cases even when the simplest procedure is used by the relatively inexperienced. But when the consequences of a mistake may be disastrous, as in blood-transfusion, and it is essential to get very near the limit of complete accuracy, it is found, as is so often the case in tests of biological material, that this can only be done by elaborate and meticulous technique in the hands of well-trained and experienced workers.

The Blood Transfusion Research Committee of the Medical Research Council has produced an admirable memorandum on this subject. A particularly lucid account is given of the principles underlying correct grouping and of the various sources of error which have been revealed by the wide experience of many workers.

The procedure of choice is a tube method, the cells being tested for agglutinogens and the serum for agglutinins. Direct matching of the donor's cells against the recipient's serum is also carried out. Should time and the necessary glassware render the tube method impracticable, a tile method may be used. In this case it is recommended that undiluted blood should not be used except by workers with long experience of the method.

The methods advocated are described in full detail, and it is recommended that one or other should now be followed by all transfusion services, without the introduction of personal modifications by less experienced workers. As the membership of the Committee shows, these recommendations have the highest authority behind them. They will doubtless be universally adopted.

An interesting account is given of the *Rh* factor, of which so much has been heard lately. There are two ways in which *Rh*-negative persons may develop in their serum immune bodies capable of agglutinating the cells of *Rh*-positive donors. The first is their development by the *Rh*-negative mother carrying an *Rh*-positive fœtus—the cause of the great majority of cases of erythroblastosis fœtalis. The second is the response of an *Rh*-negative recipient to transfusion with *Rh*-positive blood. The ideal method of preventing trouble due to these causes would be the use of *Rh*-negative blood only for *Rh*-negative recipients. Under peace-time conditions this may become possible; it may be that in the future the standard blood for transfusion will be *Rh*-negative as well as of Group *O*. In war-time this is quite impracticable. The Committee makes, however, a series of recommendations which should greatly reduce the dangers.

The practical business of blood transfusion is, of course, all-important; but the records do provide in addition a by-product of great value in the field of pure genetics. In genetics it is difficult to draw a line between pure and applied research. Any animal or plant may on occasion provide material for fundamental work. Man furnishes such an opportunity in connexion with the blood-groups, for more is known about the geographical variations of the fre-

quencies of these genes than is known in the case of any other gene whatsoever. The enrolment in wartime of vast numbers of donors has produced a correspondingly great opportunity for the extension of knowledge. But it also increases the possibility of unreliable bodies of data. Mass grouping may, on occasion, be very inaccurate as, for example, when gross errors are made through such faults as the use of stale serum or infected cells. It is true that a small percentage of errors would not matter much from this point of view, so long as they were random. Often, however, they may not be random, in which case even a small proportion of wrong groupings might lead to erroneous conclusions. For example, in the British Isles, the population of which is serologically variable, variations in the frequency of gene *A* are of great interest, as shown by the work of the Galton Laboratory and its Serum Unit. If workers in one area, owing to a lack of the precautions described in the Medical Research Council memorandum, wrongly assign a number of A_1 and A_1B persons to groups *O* and *B*, while in a neighbouring area this source of error is absent, a false conclusion on geographical or racial variation might easily be drawn.

Bernstein's well-known test does to some extent provide a check; it can be discovered whether the observed group frequencies are in unreasonable proportion. But only one degree of freedom is available, so that a discrepancy is difficult to interpret. Furthermore, errors may cancel each other (as I found in one large body of material).

The Medical Research Council memorandum should lead to much improvement. It is true that the mass statistics will usually be obtained from the registration of donors, this being carried out at a time when cells alone can be tested. Nevertheless, gross errors and biased errors should be largely eliminated: a great gain in regard to this fleeting opportunity, automatically available during a war and at no other time.

J. A. FRASER ROBERTS.

STRUCTURE OF CLOUDS

Cloud Reading for Pilots

By A. C. Douglas. Pp. x+120. (London: John Murray, 1943.) 10*s.* net.

THIS excellently illustrated little book contains 164 photographs of clouds taken by the author, who is herself a pilot. The treatment of cumulus and altocumulus is especially good, and there are several series of photographs of the same cloud taken at short intervals, showing the changes in progress. The majority of the photographs are from the ground, but a few are from the air. Both the illustrations and the descriptive matter reveal a keen and intelligent observer.

The text contains a brief outline of the physical processes of cloud formation, and includes the usual text-book diagrams of ascending air at fronts. Actually these are highly simplified, and the real processes are still imperfectly understood, providing plenty of scope for future work, from the point of view both of meteorology and of aviation. The book contains some useful hints for pilots, but an attitude of caution should be adopted towards predictions deduced from cloud structures, since the actual sequences of events are extremely variable. Prof. Brunt, in his preface to the book, indicates how the pilot can co-operate with the meteorologist and help with his own observations.

There are no major errors, and though some statements are not quite accurate, very few of these refer directly to the clouds. Strictly speaking, altocumulus castellatus (p. 77) should refer to clouds above 8,000 ft., the lower type being stratocumulus castellatus. The roll type of cloud shown in Fig. 59 is not due to thermal convection. Emphasis is rightly laid on the importance of ice-crystals in anvils, and this also holds for altostratus and all clouds from which precipitation normally originates. The distant shower shown in Fig. 60, and the "virga" (precipitation below clouds) in Fig. 62 probably consisted of snow-flakes, which form threads much more clearly visible than those due to raindrops. Indeed the melting of snow-flakes may terminate the tufts of virga, though evaporation is more frequent. A nebulous or 'watery' sky is usually due to snow-flakes or small ice-crystals.

The book can be recommended to pilots, and meteorologists can study the photographs with advantage.

INSECTS OF MEDICAL IMPORTANCE

A Handbook for the Identification of Insects of Medical Importance

By Dr. John Smart; with Chapters on Fleas, by Dr. Karl Jordan, and on Arachnids, by R. J. Whittick. Pp. x+269+13 plates. (London: British Museum (Natural History), 1943.) 15*s.*

THE great importance of certain groups of insects and other arthropods as vectors of disease-producing organisms affecting man, is universally recognized. In this way the subject of medical entomology has come into being and it is one which displays continuous rapid growth.

With an insect believed to be implicated in disease transmission, the first requisite is to ascertain its name. Accurate identification is of paramount importance, since the behaviour of closely related species may be totally different and demand different repressive measures. In normal years, time and facilities are usually available for sending specimens to a central institution for naming by specialists. Under war conditions, however, such procedure becomes greatly interfered with and an undue amount of time lost before the desired information is obtained. Often the specimens and correspondence are liable to loss in transit and the whole matter has then to be reopened on a fresh basis. The present volume is intended to obviate these drawbacks by providing the means for the identification of any insect known to be of medical importance. It is concerned with all the Old World species that come under this category. An elementary knowledge of entomology is assumed, and users of the book will find, after some practice, very little difficulty in following the tables and descriptions. These, moreover, are accompanied by good clear illustrations, many of which are original.

The authors are to be commended on having written a reliable and up-to-date treatise well adapted in every way for the purpose it is intended to serve.

A. D. IMMS.

HUMAN BLOOD GROUPS

By J. F. LOUTIT

THE blood group of a person is dependent upon the presence in his erythrocytes of specific antigens. These antigens, most easily demonstrated by agglutination methods, are usually referred to as 'agglutinogens'. The corresponding antibodies, or agglutinins, may or may not be found naturally in human sera. If not found naturally, they may be produced by an immune response in suitable human or animal subjects after the injection of erythrocytes containing the appropriate antigen.

Academically, the blood groups are of importance in the elucidation of the antigenic structure of tissue cells. Application of this knowledge to blood transfusion therapy, to medico-legal problems concerning disputed paternity, blood stains, etc., and to anthropological and genetic research follows.

First, there is a genus specificity of blood. Thus the serum of human beings will agglutinate the erythrocytes of lower animals; likewise the serum of each genus of animal will agglutinate human erythrocytes and those of other animal genera.

Secondly, there is frequently a difference between the bloods of individuals belonging to the same species. Landsteiner[1] first demonstrated this in human beings. Our knowledge of human blood groups dates from this original observation.

Landsteiner and his pupils were able to divide human beings into four groups, the groups being dependent upon the presence in the red cells of either or both of two iso-agglutinogens *A* and *B*, or their absence. An international nomenclature has been adopted on this antigenic basis, and the groups are now designated *AB*, *A*, *B* and *O* (*O* signifying absence of both *A* and *B*). Naturally-occurring iso-agglutinins α (anti-*A*) and β (anti-*B*) are found in the sera according to Landsteiner's law: Those agglutinins, and only those, are present in the serum for which there is no corresponding agglutinogen in the red blood cells. The groups are thus *AB* (*o*), *A* (β), *B* (α) and *O* (αβ). Occasionally, however, defective groups are found, for example, *A* (*o*) or *O* (α). This is rare in adults, but not uncommon in infants.

Subdivision of two of the blood groups, *A* and *AB*, was made by von Dungern and Hirzfeld[2] in 1911. Serum from a group *B* person, absorbed with certain group *A* bloods, lost its power of agglutinating other samples of these bloods, but still agglutinated most other bloods of group *A*. This phenomenon is apparently due to the presence of two iso-agglutinins in group *B* sera (and group *O* sera), α which agglutinates all group *A* and *AB* erythrocytes, and α_1 which agglutinates most but not all *A* and *AB* red cells. The bloods agglutinated by α_1 are designated A_1 and A_1B: those agglutinated only by α are A_2 and A_2B. It has been suggested that the difference between A_1 and A_2 (and A_1B and A_2B) is merely quantitative. On the other hand, there is evidence of a qualitative difference in that individuals of groups A_2 and A_2B can be immunized against A_1 blood by repeated transfusions, or, in the case of women, by bearing a child whose blood contains the antigen A_1 (Wiener[3]). Group *A* bloods which react with the iso-agglutinin even more weakly than A_2 cells have been described and denoted as $A_2{}^1$ and $A_2{}^2$. Sub-groups of the *B* agglutinogen have not been discovered. The iso-agglutinin α_1 can occur naturally in the sera of individuals of group A_2 and A_2B as well as those of group *O* and *B*. In the former cases it is usually active only in the cold below 37° C.

The agglutinogens *A* and *B* are inherited as mendelian dominants. Von Dungern and Hirzfeld[4], who first proved this, considered that the inheritance depended upon two independent pairs of allelomorphic genes. Bernstein[5] showed that this hypothesis did not fit the statistical findings, and suggested that inheritance depended upon three allelomorphic genes, *A*, *B* and *R* (or *O*). This theory is now generally accepted, with the rider that A_1, A_2, A_3 and A_4 form a series of allelomorphic genes which determine the *A* antigen.

Under von Dungern and Hirzfeld's theory, group *O* individuals would merely possess erythrocytes lacking *A* and *B* agglutinogens. With Bernstein's theory it might be expected that such cells would contain an agglutinogen "*O*". In point of fact, a water-soluble group-specific substance has been prepared from *O* cells (Hallauer[6]). Moreover, sera which will selectively agglutinate *O* cells are known (Schiff[7]). These anti-*O* sera are often designated as α_2 sera as they also agglutinate the majority of A_2 bloods, probably those of the heterozygous A_2O genotype. They occur in some natural animal sera (Schiff[8]), for example, bovine, some immune sera (Hooker and Anderson[10]) and as cold iso-agglutinins (Landsteiner and Levine[11]) in some group *B*, A_1 or A_1B human sera.

Agglutinable factors in human red cells, other than the agglutinogens *A* and *B*, have also been discovered. From certain immune rabbit sera, Landsteiner and Levine[13] obtained agglutinins for two factors which they called *M* and *N*. Human red cells can contain either or both of these agglutinogens (but *not* neither). Iso-agglutinins in human serum for *M* have been reported only in a very few instances, but no reliable report of an iso-agglutinin for *N* has appeared.

Friedenreich[13] has described a rare sub-group of *N* which has been termed N_2.

The *M* and *N* factors, as shown by Landsteiner and Levine[14], are inherited as mendelian dominants and their heredity depends upon a single pair of allelomorphic genes.

Other agglutinogens have also been reported from time to time. Of these the best-known is the factor *P*, which like the *A* substance probably represents a group of related agglutinogens[15]. The antibody can be obtained from normal and immune animal sera and occasionally in human sera (extra-agglutinin-1).

The group specific substances *A* and *B* have frequently been demonstrated in tissues other than erythrocytes (*cf.* Landsteiner and Levine[17]) by specific absorption and inhibition techniques. Schiff[18] extracted these substances in two forms, water-soluble and alcohol-soluble. Schiff[19] also found them in body fluids of certain subjects. Schiff and Sasaki[20] have called such people 'secretors': they have also found group *O* 'secretors'. The power of secretion is inherited as a mendelian dominant.

The *M* and *N* substances were for a long time thought to be confined to erythrocytes. They have lately been found in normal tissues by Kosjakov and Tribulev[21] and Boorman and Dodd[22], who also showed that the *Rh* substance (*vide infra*) was present in tissues. It would appear that *M*, *N* and *Rh* are relatively insoluble in water, as their presence in saliva is minimal.

The group specific antigens are, like other antigens, protein in nature. Haptenes derived from commercial pepsin, peptone, etc., however, have been

prepared which possess to a high degree the serological characteristics of the blood group *A* factor (Schiff and Weiler[32]) and the group *B* factor (Witebsky and Klendshoj[34]) without being themselves antigenic. They are polysaccharide complexes without protein. An artificial antigen of group *A* specificity has been prepared (Morgan[33]) by combining the *A* hapten with a protein.

Historically the latest and, from the transfusion therapy viewpoint, after *A* and *B* the most important blood group factor to be described, is *Rh*. It was first demonstrated (Landsteiner and Wiener[35]) by the use of an immune agglutinin produced in rabbits by injection of the blood of rhesus monkeys. The identity of this agglutinin with immune iso-agglutinins produced in man by repeated transfusions of blood of the correct *ABO* group[37] or by pregnancy[38,39] was soon demonstrated. In both instances persons whose erythrocytes lacked the *Rh* factor had been immunized by the *Rh* antigen. In the transfusion cases the blood transfused contained the *Rh* antigen in the erythrocytes; in the pregnancy cases it is necessary to postulate a leak of *Rh* antigen across the placental barrier from fœtus to mother.

In pregnancy, Levine, Katzin and Burnham[39] showed that this iso-immunization of the mother reflected on the newborn child, which manifested signs of 'erythroblastosis fœtalis' (hydrops fœtalis, icterus gravis neonatorum, congenital anæmia of the newborn). In view of the now accepted etiology of this condition, hæmolytic disease of the newborn is a preferable term. The immune iso-agglutinin passes back across the placenta and interacts with the fœtal erythrocytes and destroys them. Ottenberg[20] had previously suggested that this disease could be caused by iso-agglutinins α or β of the mother affecting her fœtus of group *A* or *B* respectively. The *ABO* blood groups, however, had no relation to the disease, and it is thought that the water-soluble group specific substances present in the body fluids of most *A* and *B* fœtuses would neutralize the offending agglutinin. Non-secretors would, on the other hand, be liable to be affected, and a few cases of hæmolytic disease of the newborn may be due to this cause. Immune iso-agglutinins, other than the typical *Rh*, could also produce it.

Suitable antibodies for the detection of the *Rh* factor are available by animal immunization—rabbit (Landsteiner and Wiener[36]) and guinea pig (Landsteiner and Wiener[31])—or they can be obtained from immunized human subjects. A special technique for their detection is required[31,33]. Different sera do not always give absolutely identical results, so for each *Rh* determination at least three sera should be used. In these circumstances it is found in the white populations of London[33] and New York[34] that approximately 85 per cent of persons are *Rh* positive and 15 per cent *Rh* negative.

It should be noted that, whereas 92 per cent of 153 mothers of infants with hæmolytic disease of the newborn were *Rh* negative (Levine, Burnham, Katzin and Vogel[38]), not all *Rh* negative mothers with *Rh* positive husbands (12 per cent of all matings) have affected infants. The *Rh* factor is inherited as a mendelian dominant (Landsteiner and Wiener[32]). If the father is heterozygous, *Rhrh*, half the offspring will be *Rh* negative and therefore unaffected. Even if the father be homozygous *RhRh*, although all the offspring will be *Rh* positive, one or more of the first children may be spared, because a greater degree of iso-immunizing stimulus may be necessary than is provided or the mother may be unduly resistant. In fact, it has been calculated (Javert[40]) that only 1 of every 438 newborn infants suffers from one or other form of the disease.

On the other hand, while 90 per cent approximately of mothers of infants with hæmolytic disease are *Rh* negative, the remainder are *Rh* positive. These subjects, like the *Rh* negative cases, show evidence of iso-immunization by their fœtus and provide interesting antibodies. One such antibody described by Levine, Javert and Katzin[37] and designated anti-*Hr* reacted mainly with *Rh* negative bloods, but also with some *Rh* positive bloods. A somewhat similar antibody has been denoted by Race and Taylor[41] as *St*. It agglutinated all *Rh* negative bloods and all heterozygous (*Rhrh*) bloods, but failed to agglutinate about 20 per cent of all bloods, and these must therefore be homozygous *RhRh*. Race, Taylor, Boorman and Dodd[39] report yet another antibody (*KJ*) which reacted with approximately 30 per cent of all bloods. This is similar to an antibody just reported by Wiener[40]. Race *et al.* suggest from the reactions of the *Rh*, *St* and *KJ* antibodies the probability of there being at least five allelomorphic genes: Rh_1, Rh_2, Rh_3, Rh_4 and *rh*.

It will be remembered that not all anti-*Rh* sera give identical results. 84–85 per cent of positive reactions were obtained with standard animal serum (Landsteiner and Wiener[35]); 70 per cent with a human serum described by Wiener[39] and 86–87 per cent with most human sera (Levine *et al.*[38]). Wiener now calls the standard animal serum anti-*Rh*, the 70 percenter anti-Rh_1 and the 87 percenter anti-*Rh'*. This anti-*Rh'* is really a mixture of the two agglutinins anti-*Rh* and anti-Rh_1 and, by absorption with *Rh* positive bloods which do not react with anti-Rh_1 serum, the anti-Rh_1 agglutinin can be isolated. It was postulated (Wiener and Landsteiner[41]) that bloods which reacted with this anti-Rh_1 agglutinin belonged to type Rh_1, and those that reacted only with the standard guinea pig serum to type Rh_2. Up to this point, types Rh_1 and Rh_2 were analogous to group A_1 and A_2 bloods. Some rare bloods (Landsteiner and Wiener[32]), however, react with anti-Rh_1 (and therefore anti-*Rh'*) but not with standard animal anti-*Rh*. The agglutinin, recently described by Wiener[40], reacting with 30–35 per cent of normal bloods, agglutinates bloods of so-called type Rh_3.

I have had the privilege of seeing a personal communication from Wiener, the manuscript of a paper to be published. The reactions of bloods to the agglutinins anti-*Rh*, anti-Rh_1, anti-Rh_2 and anti-*Rh'* are explained by postulating six allelic genes Rh_1, Rh_2, *Rh*, *Rh'*, *Rh''* and *rh*. *Rh''* appears to be identical with the Rh_3 of Race *et al.*, but *Rh'* appears to differ from Rh_3.

Race, Taylor, Cappell and McFarlane[42], by using an anti-Rh_1 serum in addition to anti-*Rh*, *St* and *KJ* sera, have confirmed the existence of the rare genes *Rh'* and *Rh* of Wiener, but suggest that the latter be termed Rh_3, as *Rh* has for so long had a wider meaning. The reactions of the various sera in identifying the genes can be best summarized as in the accompanying table.

By means of these four anti-sera, the genotypes of about 80 per cent of people can be determined if one ignores the rare genotypes. These latter can, however, often be detected by family studies.

The antibodies anti-Rh_1, *KJ* (anti-Rh_2), *St* and anti-*Rh* (animal) appear to be single antibodies and

Genes	Anti-sera			
	Rh	*Hr*	*KJ*	Rh_1
Rh_1	+	—	—	+
Rh_2	+	+	+	—
Rh_3	+	+	—	—
Rh'	—	—	—	+
Rh''	—	+	+	—
rh	—	+	—	—
Rh_y	?	—	+	?

not mixtures. It is tempting to postulate that these antibodies react specifically with partial antigens of the genes. Thus genes Rh_1, Rh_2 and Rh_3 would contain one common partial antigen; Rh_1 and *Rh'* another; Rh_2, *Rh''* and Rh_y yet another; and Rh_3, Rh_y, *Rh''* and *rh* a fourth. It is certain that the antibodies determine the presence of the genes wherever they occur: the various factors, therefore, appear to have equal dominance.

Although the final sorting out of the *Rh* complex and of the various anti-*Rh* agglutinins is not yet complete, it is clear that enormous strides have been made by increasing the identifiable types of human blood. Moreover, as stated by Wiener and Sonn[43], results appear to indicate that the *Rh* genes are located on a different pair of chromosomes from *ABO* genes. These in turn are located differently from *M* and *N* (Landsteiner and Levine[14]), so there are available at least four, including sex, of the twenty-four pairs of chromosomes for linkage studies in human genetics.

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UNCONSIDERED TRIFLES IN OUR DIET

VITAMIN CONTENT OF BEVERAGES

By SIR J. C. DRUMMOND and DR. T. MORAN

IT will be of interest to students of nutrition to point out some of the important results that have been obtained during the past twelve months from a re-examination of the contribution made to the nutritive value of our diet by common foods that are often ignored when evaluations are being made.

One of us (T. M.), in collaboration with Dr. J. B. Hutchinson[1], pointed out that water drunk in one form or another can add substantially to the daily calcium intake. An approximate estimate of that provided by drinking-water alone over the country as a whole was 75 mgm. a day. In some areas where the water is 'hard', the figure would be much larger. A modest pint of beer daily can provide about 70 mgm. Such quantities should not be ignored in calculating calcium intakes. Widdowson and McCance[2] have also stressed the importance of calcium from such sources, and have shown that contact of food with iron utensils often materially raises the quantity of iron in the diet.

Consideration of beer led to a re-investigation of its vitamin content. Since the original study by Harden and Zilva[3,4], it has been widely assumed that beers consumed in Great Britain have a vitamin content that is negligible. In the Medical Research Council Special Report on Vitamins[5] published in 1932, there is, however, a reference to an unpublished observation by Aykroyd that stout contains what was then known as "vitamin B_2", but no further information about this has been traced. In view of the properties of riboflavin and nicotinic acid, as contrasted with those of B_1 which is readily adsorbed by yeast, it appeared reasonable to expect that beer would contain a high proportion of the amounts of these two substances contained in the malt. This has proved to be the case. Both in the laboratories of the Cereals Research Station of the Ministry of Food and in Prof. R. H. Hopkins's Department at the University of Birmingham, riboflavin values for beers ranging from 0·5 to 1·7 μgm./c.c. have been found[6,7].

The riboflavin content of beer appears to be related to the strength of the brew. Samples of malt that we have examined have given values of 5·0 μgm./gm. (as against 2·5 μgm./gm. for barley), and on the basis of one pound of barley yielding three and a half pints of beer (corresponding roughly to present-day beer) it would follow that complete extraction of the riboflavin from the malt would give a beer of approximately 1·3 μgm./c.c. Complete extraction is unlikely, but it indicates the limiting riboflavin content. On the other hand, a sample of strong ale as supplied to Queen's College, Oxford, before the War gave a riboflavin figure of 3·9 μgm./c.c. What promised to be an even more interesting ale—a brew of 1798 to celebrate the battle of the Nile, kindly supplied to us by Mr. Julian Baker—gave the disappointing figure of 0·8 μgm./c.c. Very probably there had been some destruction of the vitamin during the intervening 150 years.

In these examinations the riboflavin values were determined by the microbiological technique[8], but a biological test on a sample of beer sent to Miss Copping

of the Lister Institute has given the value of 0·7 μgm./gm., or identical with that obtained microbiologically.

Beer is a good source not only of riboflavin but also of nicotinic acid (of the order of 15 μgm./c.c.), and it is also a reasonable assumption that it contains appreciable amounts of other recently identified nutrients, such as biotin, pantothenic acid and inositol. As regards the latter, there is appreciable destruction of phytic acid during germination, with a corresponding increase in the amount of inositol present. Thus in a sample of malted English wheat the phytate phosphorus was found to be 190 mgm. per cent as against an average figure of 270 mgm. before germination. In passing, we cannot refrain from directing attention to these new aspects of the nutritional merits of that popular lunch—bread, cheese and beer.

Brewed vinegars are also of interest in this connexion, and in the case of riboflavin have been found to have a content of approximately 0·7 μgm./c.c. Artificial vinegars, as would be expected from their composition, contain no nutrient materials.

The riboflavin content of beer seems to provide part of the explanation of the relative rarity in Great Britain of clear-cut symptoms of deficiency conditions. This is in striking contrast to what is seen in the United States and Canada. When Dr. V. P. Sydenstricker, one of the leading authorities on riboflavin and other deficiency conditions, was in England a short time ago, he was greatly impressed by the contrast but he found it difficult to give a plausible explanation. Beer drinking does not provide a complete answer, because there is no evidence that abstainers show a high incidence of signs of riboflavin deficiency. When one of us (J. C. D.) was recently in Washington, Dr. W. H. Sebrell informed him that he had obtained evidence of the presence of appreciable amounts of riboflavin in tea. This has been followed up with the following results, obtained on a few samples.

	μgm. per gm.
Tea	9·0
Coffee	1·7
Cocoa	2·7

These figures indicate that an amount of the order of 10 μgm. of riboflavin might be provided by a breakfast cup of tea. The daily quantity would certainly not be negligible in the case of the habitual tea drinker.

Following the same line of reasoning that led to the re-examination of beer, it was thought desirable to analyse commercial meat extracts. For a long time these have been dismissed by nutrition experts as of little or no value as foods. Lean meat is, however, a good source of nicotinic acid and contains an appreciable amount of riboflavin. Consideration of the methods of manufacturing meat extracts suggests that there would be considerable leaching out of these vitamins into the extract. This appears to be the case, since five well-known proprietary brands of meat extract gave riboflavin and nicotinic acid values in the ranges of 15·4–25·8 and 410–1,025 μgm./gm. respectively. A breakfast cup of these extracts would provide on the average 0·2 mgm. of riboflavin and 7 mgm. nicotinic acid. These quantities are by no means insignificant.

It is possible that the relatively high nicotinic acid content of meat extracts may prove to be related to their reputation as stimulants. The recent work of Frankau[9] is of interest in this connexion.

The experimental results reported above are only preliminary, but they are clearly of importance not only in connexion with an accurate assessment of our overall intake of nutrients but also in indicating fruitful lines of research in malting and food processing generally. It is certain that in brewing research in the future, stress will be laid on the conditions of malting and mashing that will give the maximum production of vitamins consistent with other requirements in the brewing process. Malted cereals would indeed appear to be deserving of the most careful study. Malt extracts may appear in a new light. Examination of a random concentrated sample gave a value indicating a riboflavin content of 8 μgm. per gm.; the nicotinic acid content will be correspondingly high. Malt products may, therefore, be of considerable importance as ingredients in bread and such products as breakfast foods, chick foods, etc.

Meat extracts are only half the story of meat processing; any concentration of vitamins in extracts means a corresponding poverty in corned beef. Likewise the inclusion before the completion of the process of any material extracted in the preliminary treatment of meat before drying is desirable not only on grounds of palatability but also of nutritive value.

This communication refers mainly to work being carried out at the Cereals Research Station of the Ministry of Food, St. Albans, particularly by Drs. E. C. Barton-Wright and R. G. Booth. Full details of this work will shortly be published.

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PRESERVATION OF FOODS BY DRYING

By DR FRANKLIN KIDD

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DRIED foods as a war development have been well advertised, particularly in the United States of America. With the exception of dried egg and dried skim milk ('household milk'), they have not, however, been on sale to the general public in Great Britain. The intelligent layman, therefore, in view of what he has been told through the Press about the exceptionally good quality of dried foods which modern science and technology have been able to achieve, although probably sceptical, would naturally like to try them.

An account appeared in NATURE of August 22, 1942, of a joint meeting of the Nutrition Society and of the Food Group of the Society of Chemical Industry at which the Department of Scientific and Industrial Research demonstrated the results achieved by British science during the War in improving the quality of dried foods. Dried vegetables—potato, cabbage, onions, swede—dried meat, dried egg, dried fish, dried milk and dried soups were served at lunch-time for appraisal by some hundreds of scientific and

technical workers present on that occasion. It was understood that the manufacture of products of corresponding quality was being actively developed.

Considerable interest is attached, therefore, to a recent lecture on the "Preservation of Foods by Drying" by Sir Joseph Barcroft, chairman of the Food Investigation Board of the Department of Scientific and Industrial Research, delivered at the Royal Institution on November 26.

Sir Joseph apologized at the outset for turning the lecture hall of the Royal Institution into something strongly resembling a kitchen, but aptly quoted from the original documents of the foundation, which described its objects as "for bettering the condition and increasing the comforts of the poor" by, among other things, "teaching . . . the application of science to the common purpose of life". There may be prejudice, he said, against dried foods. There is only one really adequate way to test dried foods, and that is to eat them. The *pièce de résistance* offered to the audience was a large shepherd's pie made on the demonstration bench from dried meat, dried potato, dried onion and dried milk, by Mrs. Edkins, reader in physiology in the University of London, and cooked during the lecture in Lady Dale's oven in the residency of the Director of the Institute. The audience accepted Sir Joseph's advice, and the observer records that nothing eventually remained but the dish.

In many instances acceptability to the palate has turned out to be a good criterion of nutritive value. In the case of milk and vegetables—and Sir Joseph thinks the same might be said of fish and meat—if the taste of the food is such as to make an appeal to the palate, the nutritive value of the food is largely unimpaired, and this to a physiologist with a nineteenth century background is not a little gratifying.

The drying of food aims at defeating both 'time' and 'space'. With regard to 'space', drying, combined with the process known as blocking, reduces the weight and volume of food to something like one eighth of the original. The actual reduction varies from food to food and is summarized in the accompanying table.

The same table shows how far drying combined with proper packaging and storage turns perishables into non-perishables, and so frees distribution from narrow and hampering time limits. But time is also defeated in another sense, that is, in the household, by the ready-to-eat or nearly ready-to-eat nature of the foods.

The world is shrinking. Each of us has less room and fewer hands at his disposal. Nowhere is this more important than in the kitchen. Silent forces are all the time impelling modern man to reduce his food, while retaining to the full its palatability and nutritive value, to a form occupying the smallest possible space, having the least possible weight, keeping for the longest possible time and, above all, being as near as may be ready to serve and eat.

Attainable saving calculated as between the most compact form and the form in which the commodity is most usually carried; and the *attainable storage time* after which the food is still in excellent condition, in gas-pack if necessary.

Food	Storage time	Saving per cent		Comparison with
		Weight	Bulk	
Meat	Indefinite	75	84	Frozen carcase, bone in
Fish	At least 1 year	90	85	Whole fish
Milk	Several years	87	89	Liquid milk
Egg	At least 1 year (temperature not higher than 60° F.)	80	90	Shell egg
Cabbage	2 years	95	87	Vegetables off farm
Potato	2 years	83	85	

In the sense of being ready-to-eat and having a long storage-life dried foods are alternative to canned foods. With both, refrigeration is unnecessary. Canning has had most astonishing successes; it remains to be seen whether drying, under the acid test of use in war and afterwards in peace, will be able to emulate these successes.

During the lecture the following commodities were dealt with in turn, particular emphasis being placed on the properties enumerated above—retention of nutritive value and palatability, ease of preparation, saving in weight and space and storage life. The commodities were meat, fish, vegetables (various), eggs and milk. These commodities, with the exception of fish, are now all in production, specially tuned up in the light of recent discoveries, for the needs of the War. In all cases it was pointed out that drying as a process is nothing new to human art; what is new is the retention of quality: dried meat, among dried foods, is the latest arrival. Dried eggs, vegetables, and also dried milk have been known to commerce since the War of 1914–18.

Meat.—Fresh meat is cut into small pieces, and dried in a current of hot air, after being heated for a short time to 100° C. For the full flavour of the meat all the juices escaping in cooking must be returned prior to drying, and the temperature of the drying in warm air must be carefully controlled. These are the main provisos. The quality of the product afterwards reconstituted and cooked is little, if any, inferior to that of meat which has not been dried.

The product is a uniform one, and objective standards of quality can be set for various properties, flavour, consistency, nutritive value, fat content, freedom from bacterial contamination, etc.

Above all, dried meat, as to-day defined, is whole meat, nothing having been taken out in the process of preparation except water. The cooking is simply throwing the meat into hot water and cooking immediately, the time taken being that corresponding to the time taken for fresh meat. It is possible to make any dish which requires meat reduced to a mince or to small pieces.

Fish.—Fresh fish is dried in a very similar way to meat. In the case of fish, however, both the proteins and the fats are of a more delicate and labile nature. It had at first been thought that oily fish would present a difficult problem to the dehydrator, but experience has shown that this is not in fact so.

The flavour of fish is to some extent a post-mortem development. Sir Joseph described his experience at the Torry Research Station of the Department of Scientific and Industrial Research, of what he described as a spectrum of fish-cake flavours. Really fresh fish in many cases appears to have very little flavour at all. The fact that herring can be successfully dried may be of importance in the future to the herring industry.

Vegetables.—For drying of vegetables the principle of a pre-drying heat treatment is again used, the destruction of enzymes being of great importance. The savings in weight and bulk are usually most striking; for example, in the case of cabbage, weight off the farm 25lb., weight of dried material 1 lb. The demonstration exhibited a block of dried cabbage;

it was thrown into boiling water, swelled up and was completely cooked in twenty minutes.

There are special difficulties attached to the drying of potato which centre around the fact that the starch grains are gelatinized in the pre-drying heat treatment so that, if the cellulose cell wall enclosing them is broken, sticky consistency is produced on reconstitution with water.

On the subject of the retention of vitamins, particularly vitamin C in dried leafy vegetables, an experiment was quoted in which four hundred men were divided into two groups. Cabbage was served as part of a meal; one group had cabbage of good quality bought on the market and cooked in the ordinary way by professional cooks, the other group was given reconstituted dehydrated cabbage, prepared by the same cooks. In the result less cabbage was left on the plates of the latter group, and the intake vitamin value was higher in the case of the dried cabbage than in the case of the fresh cabbage.

Milk.—Milk has always presented a difficult problem of storage. The consumer has long known of sweetened condensed milk and unsweetened evaporated milk. In this case the weight of a quart is reduced from something like 41 oz. to 17 oz. When milk is dried the weight is further reduced to between 5 and 6 oz.

Dried milk can be made which on reconstitution is scarcely, if at all, distinguishable from fresh milk. Further, it can now be stored for periods of up to a year without noticeable change in palatability or nutritive value. Sir Joseph stressed the fact that Britain is a milk-producing country, and that one of our problems had always been that of dealing with the surplus spring and summer milk which is produced in the first flush of the growth of grass. He thinks it has now become possible for the consumer to use the excess of summer milk the following winter.

General Principles.—The general principles whereby high quality is obtained in the drying of food, and the relation between drying and preservation by cold storage in the frozen condition, were briefly sketched. A process of drying foods which has not yet been developed on the commercial scale was referred to, namely, that of evaporating the ice from frozen foods without thawing—the process which is, in fact, now being used for the storage of human plasma and sera for transfusion.

One of the main principles in successful drying is the destruction of enzyme systems by pre-heat treatment; the other is the protection of the dried products from atmospheric humidity and oxygen. Careful control of temperature is always necessary.

Blocking.—On the question of blocking, it was pointed out that in the case of meat the latest development, that is, blocking, has been adopted from the outset. Besides the further saving in volume, blocking has the effect of eliminating oxygen from the pack, which in the case of meat is a hermetically sealed tin. It retards penetration of oxygen if, as in the case of certain other foods, hermetically sealed cans are not used.

Blocks of carrot and cabbage were demonstrated, and it was understood that while most of the preliminary work and development has now been done, blocking has not yet been practised on a large commercial scale except in the case of meat. In the case of dried vegetables which pack very loosely, blocking effects a big further saving in volume.

In the course of his lecture Sir Joseph said that, while he has been for the most part presenting work carried out by the Department of Scientific and Industrial Research on the advice of the Food Investigation Board, and principally at the Low Temperature Research Station, Cambridge, he wanted to say that there has been fruitful and active collaboration both with the Agricultural Research Council and the Medical Research Council throughout. The Agricultural Research Council is especially concerned with milk, and the Medical Research Council with the retention of nutritive value.

In the case of all the newly developed foods of high quality, he stressed the fact that this quality is now scientifically ascertainable and statable in objective terms so that a definite standard could be set and insisted on, and the consumer, if necessary, could be protected against exploitation. The principal properties tested at present are palatability, nutritive value and storage life. New techniques are being worked out for assaying palatability. The great development during the last three years of spray-dried egg in the United States and Canada, due to their genius for mass production, has all been subjected to rigid quality tests based on the results of researches in which Great Britain had been to a considerable extent the pioneer.

OBITUARY

Sir Robert Alexander Falconer, K.C.M.G.

ON November 8, 1943, Sir Robert Falconer was buried from the Convocation Hall of the University of Toronto, over the destinies of which he had presided for twenty-five years. An attack of coronary thrombosis in 1930 impaired his health and compelled him to retire in 1932. His father, a Canadian of Scottish ancestry, was a Presbyterian missionary for some years in Trinidad. Here his son obtained his early education; and from the West Indies won a Gilchrist Scholarship which enabled him to attend the University of Edinburgh. In those days Butcher and Sellar lectured in classics; A. S. Pringle-Pattison in philosophy; David Masson in English literature; and Chrystal and P. G. Tait in mathematics and natural philosophy. Young Falconer graduated with honours in classics and philosophy, and proceeded to the study of theology in Edinburgh, Leipzig, Berlin (under Harnack) and Marburg. He returned to Canada to become at first professor of New Testament Greek, and then principal, of Pine Hill Theological College, Halifax, Nova Scotia. Here he remained until 1907.

In that year Falconer was chosen president of the University of Toronto, which had recently been reorganized by a Royal Commission. This post in a university, which on the arts side included several federated denominational universities and colleges, required great tact, broad interests, good administrative powers and the ability to bring into happy co-operation conflicting interests. This task Sir Robert successfully accomplished. As president his first duty was to administer the new constitution in a period of national expansion. The University grew in numbers, buildings, faculties and departments. The growing needs of Canada were met by increased facilities. After the interval of the War of 1914–18, a new and rapid development followed. The president was quick to recognize and to anticipate public demands for varied types of training at the university level. When he retired in 1932, the University com-

prised the Faculties of Arts, Medicine, Engineering, Forestry, Household Science, Education, Music, Dentistry, and a promising School of Graduate Studies. In fact, it had passed from the 'college' to the 'university' stage.

While always a champion of humanistic studies, Sir Robert had keen sympathy with the scientific side of university work. Indeed he had a singularly well-balanced and catholic mind. A very great advance was made in medicine, until the Faculty of Medicine became one of the chief medical schools of America. The new Toronto General Hospital, with more than 1,200 beds, became the teaching hospital of the University, and clinical services were secured also in the Hospital for Sick Children, St. Michael's and the Western Hospitals. The gift of the Connaught Laboratories by Sir Albert Gooderham provided for the manufacture of biological products; and all profits therefrom were devoted to medical research, particularly in the field of preventive medicine. The discovery of insulin in 1922, by Sir Frederick Banting, gave an enormous impetus to scientific investigation in general. Banting became the first incumbent of the Banting and Best chair of medical research, and, on his tragic death in an air crash, his chief collaborator in the insulin investigations, Dr. Charles H. Best, succeeded him. All the royalties from the sale of insulin went into medical research. The income of the Banting Foundation (about 750,000 dollars), raised to commemorate Banting's work, was devoted to the same purpose. The Rockefeller Foundation established and endowed a School of Hygiene, which has become a centre of teaching and research in preventive medicine throughout the whole Dominion. The great physics laboratory under the leadership of the late Sir John McLennan was a hive of investigation in low-temperature experiments, in the liquefying of helium, in spectroscopy. These are but examples of the general scientific life of the University. Indeed, the spirit of research permeated every part of the University, more extensively in the domain of the physical sciences but appreciably also in the humanities and the social sciences. Of all these developments Sir Robert might truthfully have said, *quorum magna pars fui*.

Although the chief support of the University of Toronto is the annual Government grant, Sir Robert Falconer found that private benefactions were not restrained. The chief of these was the princely gift of Hart House by the Massey Foundation (the inspiring genius of which was the Right Honourable Vincent Massey, now Canadian High Commissioner in England). This is a superb stone building, in collegiate Gothic style, which serves as a social centre for men from the colleges, faculties and departments of this rather variegated institution. Another gift from the same family was the building to house the Faculty of Household Science, the donor of which was Mrs. Massey Treble, aunt of Mr. Vincent Massey.

After Sir Robert Falconer's retirement from the presidency, by careful watching over his health, he was able to do much in fields which were always of special interest to him. He was president of the Royal Society of Canada, of the Royal Canadian Institute (for popularizing scientific discoveries), of the League of Nations Society, and of the Red Cross. His interest in international affairs was perpetuated by the establishment of a lectureship which bears his name; and under which the first lecturers have been Lord Baldwin and Lord Hailey.

Always dignified, sometimes austere yet kindly withal, of judicial temperament, and of deep religious convictions, Sir Robert Falconer spent a long life of high endeavour and great accomplishment. He served well the University he loved, the Dominion of Canada and the whole of the British Empire, in the beneficent mission of which he firmly believed.

H. J. CODY.

NEWS and VIEWS

University Chair in Forestry at Bangor

THE creation of a chair of forestry at the University College of North Wales at Bangor has been recently announced, and Mr. Thomas Thomson, lecturer and head of the Forestry Department there, has been appointed as the first occupant. A lecturer in forestry was appointed in the Department of Agriculture at Bangor so long ago as 1904, Mr. Fraser Story being the first incumbent. A few years later a separate Forestry Department was created, giving full degree courses. In 1912 Mr. Thomson was appointed to the Department as assistant lecturer to Fraser Story. Two years later the Department was temporarily closed down, and the two members of the staff transferred to the Timber Supplies Department. In 1919 Fraser Story resigned, being afterwards appointed to the Forestry Commission. Thomson then held sole charge of the Department until, in 1932–33, an assistant lecturer in forestry was appointed. The head of the Department had always been a member of the Senate and Faculty. In addition to his work in the Department, Prof. Thomson has done a good deal of advisory work in North Wales, and he is the author of a translation of Busgen's "Structure and Life of Forest Trees", and, in conjunction with Mr. Jerram, lecturer in the Department, of a small book entitled, "An Outline of Forestry".

Future of Pharmacy

AN address on "The Natural History and Chemistry of Drugs" was given to the Pharmaceutical Society of Great Britain by Sir Henry Dale, president of the Royal Society, on January 13, on the occasion of the award to him of the Hanbury Memorial Medal. In the course of his address, Sir Henry considered the changes in the conceptions of drugs which current advances in the medical sciences and the changing objective of therapeutics must entail, and raised the question of the future function of pharmacy under the conditions which can be foreseen. In 1932, the "British Pharmacopœia" included representative examples of the vitamins, the hormones and the immunological products, as well as some of the earlier synthetic agents of specific chemicotherapy. This represented not merely the introduction of new remedies more effective for the old purposes, but a change in the accepted aim of medicinal treatment from the relief of symptoms to the removal or prevention of the cause of disease. This will lead in due course to changes in the pharmacist's interests. Eventually the preparation of the remedies required by progressive therapeutics will fall into the hands of scientific large-scale manufacture; and the individual pharmacist will presumably become little more than an intelligent retail distributor of ready-made and centrally standardized products.

Important changes in the organization of medical practice will be necessary if the great advances which research is producing in methods of diagnosis and treatment are to be made properly available for the ordinary citizen in his home. Unless the medical practitioner is to become a mere sorting machine to secure the transfer to hospital of every case requiring serious scientific attention, he will require the services of an organization such as the common laboratory facilities which any modern hospital affords. This would require a very large number of new laboratory centres with well-trained men, and the profession of pharmacy should be interested. Some of the procedures commonly regarded as biochemical and now used in the control of some modern medication are nothing but applications to a biological vehicle, such as blood or urine, of pharmaceutical methods of assay, such as students of pharmacy still learn. Sir Henry Dale therefore suggested that "the nearest equivalent to the expert co-operation which was afforded by the work of Daniel Hanbury and the pharmacists of that old tradition to the medicinal treatment of their own days may be found under modern conditions in the aid which diagnosis and treatment still increasingly need from the laboratory".

British Coal Utilization Research Association

THE annual meeting of the British Coal Utilisation Research Association was held in London on December 15, 1943. In his presidential address, Sir Evan Williams, Bart., gave an account of the present attainments and plans of the Association, now the largest co-operative industrial research enterprise in Great Britain. The original grant by the coal owners has been doubled. It is planned to extend the research work to include the production of liquid fuels and chemical products, and for this the colliery owners are contributing in the next two or three years a fund up to £500,000. It is hoped to improve on the Fischer-Tropsch process. Efforts to increase the efficiency of coal utilization are already an important branch of the Association's work and, while bringing aid to the consumer, are anticipated to lead to a greater demand for coal. Prominent in this direction is the attention paid to the design of the open fire, for which great improvement in heat efficiency and convenience is claimed. It is a matter of experience that the greatest obstacle to technical progress is often the transference of new laboratory discoveries to commercial success. Recognizing this, the Association is planning to undertake the trial manufacture of new appliances and the pilot plant operation of new processes. For this purpose, a large site for a research station has been acquired at Leatherhead. From this, it will be seen that a scheme is envisaged on a scale worthy of so great a national problem.

It may be questioned, however, whether the ambition to increase the demand for coal is a proper ideal. In this connexion the statement that the Association aims at increasing the consumption of coal—the most precious but waning asset of Great Britain—reads curiously. War-time experience raises a question as to whether we should not be developing alternative sources of power while conserving coal for use as fuel and sources of chemical products. Moreover, it should not be forgotten that research has been and is being prosecuted by the fuel industries, and that its progress will be determined, not merely by the expenditure of money, but by the supply of effective staff.

Imperial College and 'M.I.T.'

PROF. R. V. SOUTHWELL, rector of the Imperial College of Science and Technology, London, has announced in a letter in *The Times* that the College has come to an arrangement with the Massachusetts Institute of Technology whereby the two institutions will maintain, after the War, a regular interchange of staff and postgraduate students. The Massachusetts Institute of Technology, or more briefly, 'M.I.T.', has a history of eighty years of activity which has made it known throughout the world as a centre for postgraduate instruction and research in science and technology. Indeed, it was planned specifically for this purpose, its charter stating among its purposes "the advancement, development and practical applications of science in connection with arts, agriculture, manufactures and commerce". The Imperial College in London has a very different history. It arose, as is often the way in Great Britain, by the fusion of three existing colleges, the Royal College of Science, the Royal School of Mines, and the City and Guilds College, which from being physically neighbours became associated by Royal Charter in 1907. The College provides advanced specialized instruction and equipment in various branches of science, especially in its application to industry, and is administered by a board including representatives of the Crown, the Indian Empire, the self-governing Dominions, the Board of Education, the London County Council, the Royal Society and other bodies. During the War, there has been gradually increasing interchange of information on scientific and technical developments between Great Britain and the United States, and the association of these two colleges in the intimate relationship involved in exchange of staff and students is a guarantee that Anglo-American collaboration in the fields of science and technology is to continue.

Work of Benjamin Huntsman

AT a meeting of the Newcomen Society held on January 12 at the Iron and Steel Institute, Mr. E. W. Hulme read a paper "On the Pedigree and Career of Benjamin Huntsman, Inventor in Europe of Crucible Steel". Various fictitious accounts have been given of Huntsman and his invention, and it has been said that he was the son of indigent parents. As a matter of fact he came of the Quaker family of Huntsman of Epworth, Lincolnshire, well known for their good social standing. Benjamin began his career as a watch-maker's apprentice, and he remained at this craft all his life. He set up for himself at Doncaster, about 1740–44 removed to Handsworth, Sheffield, and in 1770 to Attercliffe, where the firm he founded still is active. He died at Attercliffe in 1776. It was to remedy the defective working of watch-springs that he was led to invent a new kind of steel, and there is ample proof of his great metallurgical and mechanical skill. Cast steel made in a crucible heated in a charcoal fire supplied with a forced draught is an invention of unknown antiquity. It was known as "Wootz" steel, and was exported from southern India to Damascus, where it was called 'Damascus' steel. It was this steel Huntsman set himself to imitate, but the crux of the invention was how to make crucibles that would stand high temperatures. Of Huntsman's character little is known with certainty. At one time, it was suggested that he should be put up for election to the Royal Society, but he declined the honour.

Fungi for Food

THE larger fungi contain appreciable amounts of protein, carbohydrates and vitamins suitable for human nutrition, but their unique flavours, compounded from a plethora of little-known substances, make an even greater contribution to gastronomic variety. Dr. J. Ramsbottom is trying to stimulate interest in a wider use of our native fungi, and in a recent short paper (*J. Roy. Hort. Soc.*, 68, Pt. 10; Oct. 1943) describes fourteen species which might supplement the mushroom in our diet. The chanterelle (*Cantharellus cibarius*), blewits (*Tricholoma personatum* and the related *T. nudum*) and the morel (*Morchella esculenta*) may already be known to some connoisseurs, but the others are no less tasty. The great need appears to be for inspiration in methods of cooking. Dr. Ramsbottom has made a start in this direction, but much yet remains to be accomplished. The common *Hygrophorus pratensis*, for example, though palatable in the raw state, can be converted into a tough leathery mass by incorrect culinary preparation. All the species mentioned in Dr. Ramsbottom's paper, however, can be trusted to yield their flavour, and stimulate the palate, even with ordinary methods of cooking.

Poisonous Gases in the Exhaust of Diesel Engines

DR. ENRIQUE CASTELLANO has an article on this subject in *Publicaciones de la Facultad de Ciencias Fisicomatematicas, Universidad Nacional de la Plata* (June 1943), in which he gives a full account of his experiments to discover if pernicious effects are produced in the driver's cabin by the fumes from the exhaust. A description is given of the methods adopted for determining the amount of each of the gases ejected, and the results are summarized at the end of the paper. Comparing the figures with those for the concentration dangerous to human life for each gas, it is interesting to notice that there is a large margin in the concentration of carbon monoxide —a gas which is generally believed to be extremely dangerous in the fumes from the exhaust.

	Concentration in parts per thousand in Diesel exhaust	Maximum safe concentration
Carbon dioxide	0·77	5·5
Carbon monoxide	0·0046	0·05
Hydrogen sulphide	0·000058	0·02
Sulphur dioxide, etc. ..	0·00015	0·01
Oxides of nitrogen	0·0020	0·01
Aldehydes	0·000046 gm./m.³	0·02 gm./m.³
Carbon	0·0023	
Oils, hydrocarbons not burnt or only partly burnt	0·00046	

From these figures it appears that the concentration of gases in the cabin is far below that which is usually considered detrimental to life. In the case of the hydrocarbons and carbon, it is impossible to draw any definite conclusions, because no figures are available regarding the concentrations which are considered dangerous to human life.

Portuguese Navigators

REFERRING to the article in NATURE of November 27 on "Anglo-Portuguese Scientific Relations", Mr. Arthur J. Hughes, of Messrs. Henry Hughes and Son, Ltd., nautical and aeronautical instrument manufacturers, remarks that "the work of Prince Henry the Navigator is still being gloriously continued in Portugal. Perhaps two of the greatest navigators of the air were the late Comdr. Cabral and Admiral Coutinho, of the Portuguese Navy, who crossed the Atlantic in 1922, on the way making a brilliant landing at the Azores by close and accurate navigation. There is in Brazil to-day a great descendant of the Portuguese, Capt. Radler Acquino, who is an acknowledged expert on all methods of modern navigation. He has just published a new book of tables in Portuguese, which would delight the heart of Henry the Navigator by their simplicity. There are also tables in navigation by distinguished Portuguese navigators, Newton and Pinto, in 1930 and 1933, and there is a very close scientific connexion in nautical science and hydrography between the Portuguese and British Navies."

Newton's Verses

NEWTON'S habit of transcribing passages from the writings of others has misled some writers into regarding him as something of an alchemist. Prof. E. N. da C. Andrade now concludes (*Proc. Phys. Soc.*, 55, 426; 1943) that the same habit has misled those authors who have regarded Newton as something of a poet. When he was a boy, Newton apparently drew a picture of Charles I and wrote some verses underneath. Mrs. Vincent of Grantham repeated them by memory to Stukeley, who adds, "She fancyed, and aver'd it that he composed them himself. I rather suppose he copyed the print prefixed to the *Eikon basilice*". Prof. Andrade reproduces the verses from the "Eikon basilice". Comparison of the two versions suggests that Newton omitted the last six lines in transcribing the verses, and that Mrs. Vincent may have recollected imperfectly what he wrote. A recent biographer wrote: "These are very good verses in the fashion of the day to be written by a boy of his age". Prof. Andrade concludes: "The Eikon basilice verses, though poor and conventional, show some slight feeling for poetry. I do not think that Newton can ever have written anything even as good as this."

Comet Peltier-Kellaway

COMET PELTIER-KELLAWAY was discovered by Peltier on December 17 and independently by G. F. Kellaway, West Coker, Somerset, on December 19. Its magnitude at the time of discovery was about 6. It made its closest approach to the sun on January 19 and is becoming fainter.

Announcements

PROF. NIELS BOHR, professor of theoretical physics, University of Copenhagen, has been elected a member of the Athenæum under Rule II of the club, which permits the "annual election by the committee of a certain number of persons of distinguished eminence in science, literature, or the arts, or for their public services".

DR. R. E. MORTIMER WHEELER, director of the Society of Antiquaries and keeper of the London Museum, has been appointed director-general of archæology in India.

IT is announced that the ship-building industry in Great Britain, after consultation with the Department of Scientific and Industrial Research and the Admiralty, has decided to establish a British Ship-building Research Association, to develop all branches of research associated with ship-building, marine engineering and ship repairing.

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. No notice is taken of anonymous communications.

Mutation and the Rhesus Reaction

IN his interesting letter[1] on genetics of the *Rh* antigen in man, Prof. L. T. Hogben advances two hypotheses. The first is that the frequency of the *rh* gene, determining the absence of the antigen, is approximately constant from one generation to another in human populations. The second is that this constancy is due to the formation of new *rh* genes by mutation, at a rate which replaces those eliminated by the deaths of heterozygotes from erythroblastosis fœtalis. Thus such populations as those of England and the United States are thought to be in equilibrium.

Prof. Hogben does not refer to the earlier work of Wiener[2] and Haldane[3] on this question, perhaps because the latter at least requires some revision in the light of later observations. Neither Wiener nor Haldane believed that the present frequency of the *rh* gene was stable, and they ascribed it to the formation of the Western European people by (geologically) recent crossing between a race in which the *rh* gene was very rare, as it is[4] in American Indians, and one in which it was very common. Haldane calculated that selection at its present intensity would reduce the frequency of *Rh*-negative individuals from its present mean American value of 14 to 1 per cent in about six hundred generations.

Whether or not the theory of racial crossing is accepted, there is a sound reason for rejecting Prof. Hogben's theory, namely, that the equilibrium which he postulates would be unstable. Let t be the time measured in generations, p the frequency of the *rh* gene, $1 - k$ the ratio of the mean viability of *Rh rh* children of *rh rh* mothers to that of other babies, and μ the frequency with which *Rh* (or a group of dominant allelomorphs) mutates to *rh* per generation. Then it follows from the argument given by Haldane[3] that

$$\frac{dp}{dt} = \mu(1-p) - kp^2(1-p)\left(\tfrac{1}{2} - p\right) + O(k^2).$$

Hence at equilibrium $\mu = kp^2\left(\frac{1}{2} - p\right)$. Among American whites $p = 0{\cdot}39$, so if they are in equilibrium $\mu = 0{\cdot}016731k$. If p is slightly increased, say, to 0·40, $\frac{dp}{dt} = +\,0{\cdot}0004386k$, so it will tend to increase further. If it is slightly diminished to 0·38, $\frac{dp}{dt} = -\,0{\cdot}000370k$, so it will tend to diminish further. If $\mu = 0{\cdot}016731k$ the only stable equilibria are given by $p = 1$ and $p = 0{\cdot}27$.

In general, the condition for stability is that $\frac{d}{dp}\left(\frac{dp}{dt}\right)$ should be negative in the neighbourhood of the equilibrium. It can readily be shown that this is only possible, whatever the mutation-rate, if $p < 1/3$. The existence of unstable equilibria between selection and mutation was pointed out by Haldane[5], and it is always desirable to investigate the stability of postulated equilibria of this kind.

While it would seem that Prof. Hogben's theory must be rejected, I do not wish to suggest that my own should therefore be accepted. Its acceptance must depend, among other things, on research into the frequency of different allelomorphs at the *Rh* locus in various populations, and I fully support Prof. Hogben's plea for more such research. This is particularly desirable in Asiatic populations where, if anywhere, a high frequency of *rh* might be expected.

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[1] Hogben, NATURE, 152, 721 (1943).
[2] Wiener, *Science*, 96, 407 (1942).
[3] Haldane, *Ann. Eug.*, 11, 333 (1942).
[4] Landsteiner, Wiener and Matson, *J. Exp. Med.*, 76, 73 (1942).
[5] Haldane, *Proc. Camb. Phil. Soc.*, 23, 838 (1927).

IN NATURE of December 18, Prof. L. Hogben has discussed the question of gene equilibrium in the Rhesus blood-group factor, and draws the conclusion that a mutation-rate from Rhesus-positive to Rhesus-negative genes of quite unprecedented magnitude can be inferred from what is at present known of the genetic situation and the medical facts.

With the importance of obtaining direct and unbiased data of the vital statistics of marriages between different genotypes we are in most hearty agreement; and, indeed, have already taken preliminary steps toward a direct ascertainment of these factors. The situation in some respects, however, does not appear to us to have been correctly stated by Prof. Hogben; in particular, we would dissociate ourselves from the statement that "Levine's hypothesis postulates a form of adverse selection. . . ." It appears to us, on the contrary, that the evidence for Levine's theory of the causation of hæmolytic disease of the newborn is completely independent of any such postulate, and would be equally convincing whether there is or is not any such selective influence at work. It would also be wrong to infer a selective elimination of the rarer gene from a demonstrable elimination of heterozygotes, unless we knew, as we do not know, that fertility is not concurrently affected.

Finally, we do not think that Prof. Hogben's theory of an abnormal mutation-rate gains any confirmation from the rather extensive system of multiple allelomorphs of the Rhesus factor recently demonstrated at the Galton Laboratory Serum Unit and elsewhere. Speaking of his mutation-rate, Hogben says: "on the other hand, its value is not inordinately high if we interpret μ to signify the rate of mutation at the *Rh* locus from *any one of a series* of 5 or more dominant alleles". Of the seven allelomorphs we now postulate, not more than four are Rhesus-positive, while three are Rhesus-negative. Moreover, we do not see that the mutation theory is aided by the supposition that the hypothetical mutation is derived from any one rather than equally from all of the possible sources.

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The Human Side of Anthropology

THE recent editorial in NATURE[1] made out a very strong case for the importance of the social sciences as a scientific contribution to the welfare of the community; and in the same issue, Prof. Le Gros Clark directed attention to some of the rich and interesting

fields open to the exploitation of the 'physical anthropologists'. As the editorial pointed out, the scope and power of non-experimental and statistical methods of analysis are becoming more widely appreciated—a movement of opinion which will undoubtedly have been encouraged by the experience of the application of science to war. It is probable, therefore, that most men of science will be disposed to wish the social scientific workers well in their endeavours to win a more favourable place in the sun.

One is also grateful for the strong emphasis which the British Association Committee on Scientific Research on Human Institutions, to which the editorial refers, has placed on the necessity for an empirical and where possible a quantitative approach. Perhaps one can recognize here the hand of Prof. L. Hogben, whose spirited invective against the more fanciful constructs of deductive theorists has so often amused and stimulated his readers in the past. But while in no way calling this emphasis in question, I wish to suggest that there is a danger that this attitude, desirable in itself, may lead to the neglect of one very important side of anthropological inquiry —indeed, the one branch of the subject which deals with those aspects of man in which he differs most completely from other animals. Human birth- and death-rates can be studied with the same theoretical apparatus as those of Drosophila; human nutrition is a problem very similar to that solved by the directors of the Zoo; 'social security', in the sense of support during illness and after retirement, we already provide for some of our domestic animals. The characteristically human is to be found in the general field of education and social life—two mutually dependent functions which together bring it about that man's evolutionary advance is mediated by processes quite unlike those found anywhere else in the animal kingdom. The study of the interrelations between the upbringing of children and the structure of the society into which they are being initiated is in its infancy, but it has been begun, particularly by American scientific workers. The Lynds and some of the Chicago school touched on it, and it has been considerably developed by authors such as Benedict, Mead and Bateson, on the sociological side, while the work of many psychologists impinges on it at another angle.

Investigations in this field have an essential part to play in solving the problems of reconstruction facing us. For example, we need to know how far it is true, and for what reasons, that the concept of 'social security' has a great appeal to British people, while to many Americans it seems to cloak the apathy of a nation which has lost its saving faith in the virtues of 'rugged individualism'. Again, we hear much of the need for the re-education of Germany; but have we any clear idea of the features in German social life which produce the attitude of unquestioning subordination to superiors, and callous domination over inferiors, that we wish to eradicate? A recent example of how such questions can be tackled is provided by the important book of Bateson and Mead on "Balinese Character" and Mead's later and more popular "—And Keep Your Powder Dry"[2].

It is much to be hoped that such studies will be encouraged in any general policy for the development of social sciences in Great Britain. The infant science needs protection, on one hand against the view that such subjects cannot be made amenable to scientific study, and on the other against the ideological contention that social characteristics spring so directly from the economic set-up that there is nothing to be gained by a close study of them.

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[1] NATURE, 152, 669 (1943).
[2] "Balinese Character", by G. Bateson and M. Mead (New York Acad. Sci., 1943). "And Keep Your Powder Dry", by M. Mead (New York, 1943); see NATURE, 151, 405 (1943).

Activity of Purified Carbonic Anhydrase

WE have shown previously that carbonic anhydrase is a zinc-protein compound[1,2] and this was confirmed by other workers[3,4]. That the catalytic activity of carbonic anhydrase, unlike the physiological activity of insulin, depends on the presence of zinc in its molecule is strongly supported by the following considerations. (1) An instantaneous, strong and perfectly reversible inhibition of carbonic anhydrase by very small concentrations of potassium cyanide, hydrogen sulphide and sodium azide which react in this way only with metals. (2) The presence of high concentrations of zinc in purified enzyme preparations obtained by different methods and from different materials. (3) The proportionality between the zinc content of different fractions and their catalytic activity. (4) The absence of other metals from purified enzyme preparations.

Our purest enzyme preparation, having approximately 2,220 enzyme units per mgm. dry weight[2], was a colourless protein containing 14·8 per cent nitrogen and 0·3–0·33 per cent zinc. As this preparation appeared homogeneous in the Tiselius apparatus[3] and in an ultracentrifuge[2], it may be considered as either pure or almost pure enzyme. It was therefore a matter of some surprise to us when Scott and Mendive[4] announced that they had obtained an enzyme preparation containing 9,000–10,000 enzyme units per mgm. dry weight with a zinc content of 0·2–0·23 per cent. Their preparations appeared, therefore, to be 4–4·5 times more active than our purest preparation. However, a careful examination of their methods of estimation of enzyme activity revealed that the high value obtained by them is only an apparent one. Their estimations were carried out in the presence of a small amount of peptone; this has the property not only of stabilizing the purified enzyme, which is very fragile in dilute solutions, but also of doubling the activity of freshly diluted purified enzyme. This factor alone would make their activity values appear at least double those given in our paper. On the other hand, peptone produces no activating effect on the carbonic anhydrase in laked blood corpuscles, which is probably due to the high concentration of proteins already available. Yet, the activity of laked corpuscles estimated by these workers was about twice as high as the value found by us. Thus in corpuscles of 18 l. of blood they found about 71 million enzyme units, whereas the same amount of blood according to our estimation contained only 37 million enzyme units.

As this discrepancy cannot be ascribed either to the possible use of peptone by these workers or to the differences in enzyme content of ox blood in Great Britain and in Canada, it can only be due to a difference in the values of the enzyme units used by us and by these workers. In this way, Scott and Mendive[4] have introduced a second factor which doubles the activity of their enzyme preparations.

The numerical value expressing the activity of their enzyme was therefore raised artificially at least four times. In other words, the activity of their best enzyme preparation expressed in our enzyme units and estimated by our method will be approximately the same as that of our pure preparation.

The comparatively low zinc content found by these workers may be due to the method of Sahyum and Feldkamp which they used and which, unlike the dithizone method used by us, requires larger amounts of zinc and invariably gives low zinc values. Their exceptionally high yield, of up to 50 per cent of purified enzyme compared with our maximum yield of 30 per cent, can only be explained by the effect of peptone which, as they have shown, doubles the activity of purified enzyme preparations.

As to the crystals of carbonic anhydrase obtained by Scott and Fisher[4], the thin plates described and photographed by them as crystals of ammonium–carbonic anhydrase show scarcely any crystalline structure and were often observed by us during precipitation of the purified enzyme. On the other hand, the crystals of alleged compounds of carbonic anhydrase with piperidine, *iso*amylamine and *n*-amylamine described by these workers have no relationship to the enzyme. In fact, these crystals, as shown by Scott and Fisher[4], are completely devoid of catalytic activity. They are obviously the crystals of salts of these bases mixed with denatured protein of carbonic anhydrase, which protects them from evaporation. They can even be obtained with gelatin instead of carbonic anhydrase.

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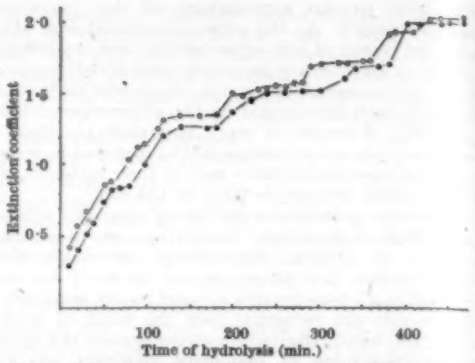
Slow Protein Hydrolysis in the Presence of 2,4-Dinitrophenylhydrazine

IN our search for reactive keto groups in the protein molecule, we found that 2,4-dinitrophenylhydrazine could be coupled with the protein framework to a surprisingly great extent (one molecule of the hydrazine to about six amino-acid residues). In a typical experiment, 100 gm. casein ("nach Hammarsten") was boiled with 1,000 c.c. 0·3 *N* hydrochloric acid and 10 gm. 2,4-dinitrophenylhydrazine. From time to time 4 c.c. samples of the mixture were removed, precipitated with 5 c.c. 10 per cent trichloroacetic acid, centrifuged, and 2 c.c. of the supernatant liquid and the whole of the precipitate dissolved in *N* sodium hydroxide, each to a total volume of 50 c.c. The extinction coefficients of these deep red solutions were measured in a Zeiss colorimeter (green filter, 0·5 cm. cuvette). When the hydrazine is not coupled, the red colour fades immediately. The intensity of the permanent colour is found to be proportional to the amount of hydrazine bound in a similar manner to that occurring in hydrazones[1].

It first occurred to us that, during hydrolysis, free amino-groups had been subjected to oxidation, and that the resulting keto or aldehyde groups had become



100 GM. CASEIN, 1,000 C.C. 0·3 *N* HCl, 10 GM. 2,4-DINITROPHENYLHYDRAZINE HEATED AT 96° WITH RAPID STIRRING. EACH POINT REPRESENTS THE MEAN OF THREE MEASUREMENTS.

coupled with the hydrazine. The ammonia produced in the hydrolysis proved, however, to be even less in the presence of the hydrazine than in its absence. This would appear to exclude the possibility of oxidative de-amination, which would necessarily involve the freeing of ketonic acids into the solution. Furthermore, it was found that most of the hydrazine was coupled to the high-molecular fraction precipitable with trichloracetic acid. Spectrometric investigations of the red colour formed here, and that arising in the dissolution of pyruvic acid 2,4-dinitrophenylhydrazone in alkali, showed that the absorption spectra were almost identical in the two cases. It would thus seem that, at least after a short period of hydrolysis, groups are present in the protein framework which, without being ketone or aldehyde structures, permit the coupling of the hydrazine in the normal manner, that is, with the formation of the group =N—N=CR—. It may be mentioned that the dipeptides of amino-acids (for example, glycyl glycine and leucyl leucine) do not give this reaction. Tyrosine and arginine give very weak reactions of the same type.

A consideration of the possible seats of the reaction has led us to the tentative conclusion that the occurrence of amidine groups in the protein framework would provide an explanation for the observed phenomenon. A mechanism for the formation of the amidine structure in the protein framework may be found in the condensation of two adjacent peptide bonds, one of the normal and one of the enolized type:

$$\begin{matrix} -C(OH)=N- \\ -NH-CO- \end{matrix} \longrightarrow \begin{matrix} -C=N- \\ | \\ -N-CO- \end{matrix}$$

An arrangement of such amidine groups regularly distributed through the protein molecule permits a rigid fixation of the polypeptide chains into a framework more clearly defined in the crystalline sense. During hydrolysis in the absence of hydrazine, the amidine groups may each take up one molecule of water, thus causing disintegration into polypeptide chains, which may then be subject to further hydrolysis. The hydrazine molecule may break the —C=N— bonds of the amidine structure and thus become coupled with the high-molecular framework.

Experiments with benzoyl aminoacetamidine and other amidines show that these all react with 2,4-dinitrophenylhydrazine, giving very strong colour reactions of the same type. It is, indeed, well known

that amidines react with phenylhydrazines in such a manner that the imino group is exchanged for the reactive group of the hydrazine.

It is also of interest to note that the reaction of the 2,4-dinitrophenylhydrazine under our mild hydrolytic conditions is by no means continuous. Curves showing the relation between time of hydrolysis and colour intensity of the solution in sodium hydroxide of the fraction precipitated by trichloracetic acid exhibit definite discontinuities which are, in principle, reproducible. A pair of typical curves is shown in the accompanying graph. While no explanation of the phenomenon can be given at present, it is conceivable that it is connected in some manner with a successive destruction and regeneration of groups capable of fixing the hydrazine. This in turn may be related to the discontinuous liberation of tyrosine and arginine which we have observed colorimetrically in the filtrates from the trichloracetic acid precipitations in the absence of 2,4-dinitrophenylhydrazine.

An extended account of this work will be published elsewhere.

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Distribution of Nucleic Acid in the Cell

THE statements which Stedman and Stedman[1,2,3] have published in NATURE must, it seems, be considered from two points of view. First, there is their chemical analysis leading to the discovery of "chromosomin". Secondly, there are the biological consequences which they have inferred from this discovery. Clearly, the chemical analysis is the foundation of everything else; but since no particulars of this analysis have been published, we can deal only with the superstructure.

The chief of Stedman and Stedman's inferences concerns the distribution of thymo-nucleic acid in the nucleus. They infer that the bulk of the thymonucleic acid lies in the nuclear sap, not in the chromosomes. Their own tables, however, demonstrate the contrary. They have determined the proportion of thymonucleic acid in the dry weight of nuclei varying between the extremes of no nuclear sap in cod sperm to, say, 90 per cent in carcinoma cells. The small variation in proportion of thymonucleic acid is not correlated with the proportion of nuclear sap. Yet it is on the basis of these results that Stedman and Stedman proceed to dismiss the work of Mazia and Jaeger, Caspersson, Norberg and Barigozzi[4], who by four different methods have converged on the conclusion that thymonucleic acid exists in the cell only in structural relationship with the chromosomes.

This conclusion continues to be reinforced by new evidence. For example, Claude and Potter[5] have recently, by a simple technique, isolated chromosome threads from resting nuclei. By chemical analysis of the threads they conclude that 40 per cent is thymonucleic acid, which agrees closely enough with the proportion determined by Norberg, and the threads were, of course, Feulgen positive. Thus thymonucleic acid was evidently attached to the chromosome threads before their isolation. Stedman and Stedman's theory of indirect staining by Feulgen's reagent becomes meaningless in the light of this experiment. On the other hand, Choudhuri's observation[6] of the staining of chromosomes by "developed Feulgen reagent", which has been used by Stedman and Stedman in support of their theory, is, of course, merely another example of the use of a basic dye.

Stedman and Stedman's view that thymonucleic acid is the main solid constituent of the nuclear sap leads them further: "it is an attractive hypothesis", they say[1], "but one for which there is no direct experimental proof, that the spindle which is formed at metaphase is a gel of nucleic acid". Later[3] they state, without additional evidence, that "there seems little doubt that nucleic acid is concerned mainly with spindle formation".

Darlington[7] has given reasons for believing that the development of the spindle depends on a reaction between the centromeres of the chromosomes and fibre-forming molecules of a type not usually found within the nuclear membrane. The spindle can therefore develop only after the breakdown of the nuclear membrane. With regard to the nature of these fibre-forming molecules, most workers have contented themselves with the evidence that the spindle, like other cytoplasmic constituents, does not contain thymonucleic acid. On this point the work of Schmidt and others on birefringence is directly significant. Schmidt[8], Runström[9] and Nakamura[10] have shown that the spindle fibres are positively birefringent with respect to their length, whereas pure sodium thymonucleate fibres are negatively birefringent, thus giving the peculiar optical properties actually found in the chromosomes.

In the light of this evidence, we feel that the position and function of "chromosomin" in the nucleus will have to be determined in relation to the already well-established position and function of thymonucleic acid.

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Influence of an Adsorbed (Inner) Layer on the Cohesion of a Solid

IN a previous communication[1] attention was directed to the influence of adsorption in causing the phenomenon of floating drops. In other words, an adsorbed layer (in particular of gases), when enclosed within a liquid, may lessen its cohesion so that no coalescence takes place, the adsorbed layer acting as a barrier. Thus a drop of molten paraffin—where adsorption may be expected—persists for a relatively long time, say, 1 min., on a paraffin surface.

These observations were extended to solid paraffin, using the following principle. Two plane surfaces

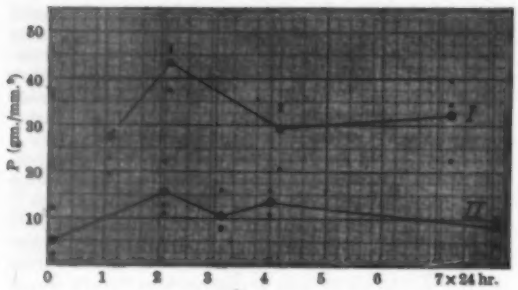

Fig. 1.

of two paraffin cylinders, if brought into contact under a definite pressure, will stick more or less firmly. This provides a measure of the resulting cohesion at the contact surface. Two cases may be considered: (1) If the surfaces have been formed by cutting at room temperature, no sensible adsorption is to be expected. (2) If the cut specimens have been exposed to tempering, a sensible adsorption in the surfaces may be expected. Accordingly, a lessened cohesion ought to occur.

Small cylinders of paraffin (melting at 68–72° C.) were cast in a shape permitting traction tests to be performed. The plane surfaces were smoothed, using a special, sharp turning tool. Two cylinders were pressed together in a small press, using constant load, and time.

The following figures were first obtained.

Treatment after plane turning	Average 'tensile strength'
No tempering	323 gm.
Tempering at 40° C., 17 hr. ..	320 ,,
Tempering at 50° C., 17 hr. ..	17 ,,

While tempering at 40° had practically no effect, tempering at 50° gave a strikingly low tensile strength, intimating that effective adsorption had occurred.

The final tests are exemplified by Fig. 1. The specimens tempered at 50° C. (II) show a considerably lower strength than the untempered ones (I), confirming the above result. Similar data were obtained with paraffin melting at 75–80° C.

Thus, *an adsorbed layer considerably lowers the cohesion appearing in solid paraffin.*

This having been established, similar tests were attempted on lead. The cut surfaces were brought together (1) as soon as possible after cutting, and (2) after a definite period t, permitting the air to form a thin foreign layer on the surfaces. This foreign layer was found strongly to diminish the cohesion. The results, however, were irregular, on account of too rapid formation of the adsorbed (oxide) layer.

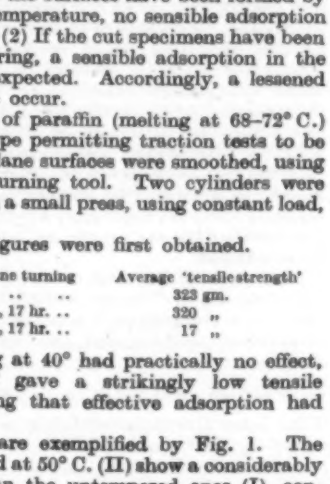

Fig. 2.

Tin was found to be more appropriate. Fig. 2 illustrates the tensile strengths P obtained after different times t of exposure after cutting. It will be seen that the average values (circles) lie fairly well on a smooth curve. This gives evidence that on increasing exposure time t a striking decrease of the sticking power occurs, so that after $t = 10$ min., no sticking whatever was obtained. At first the slope of the curve is very steep. We infer that even an extremely thin adsorbed layer strongly diminishes cohesion with solid tin.

The conclusion is thus that the action exerted by a thin (adsorbed) layer in lowering cohesion, which has been evidenced for different liquids and now for solid paraffin, likewise occurs in the case of a solid metal (lead and tin). This experimental result is important in the phenomenon of grain growth in metals.

Further details will appear in *Arkiv för Matematik, Astronomi och Fysik*, vol. 30 A, of the Royal Swedish Academy of Sciences, Stockholm.

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[1] NATURE [153, 80 (1944)].

Biology of the Malarial Parasite in the Vertebrate Host

DURING the last few years an increasing amount of interest has been centred in the so-called exoerythrocytic stage which has been demonstrated in the life-cycle of certain malarial parasites of birds. The first really clear proof that schizogony of a malarial parasite could occur in cells other than red blood corpuscles was given by Huff and Bloom[1], who demonstrated that *Plasmodium elongatum* successfully parasitized not only erythrocytes, but also monocytes and lymphocytes, and a variety of cells in the bone-marrow and the spleen. Next Raffaele[2] described some tissue forms of *Plasmodium relictum* found by him in canaries which had been infected by means of sporozoites, but it was the work of James and Tate[4] which finally attracted the attention of malariologists all over the world to the possible great importance of what they called an exoerythrocytic stage in the life-cycle of malarial parasites. They found that the schizogonic cycle of *Plasmodium gallinaceum* in chickens took place not only in the erythrocytes, but also in endothelial cells throughout the tissues of the body. The parasites in the endothelial cells developed to a much larger size than in the erythrocytes, and also, because of the absence of hæmoglobin from the host cells, they were unpigmented. They were plentiful in the endothelial cells of the brain and spleen, but easily found, too, in the liver, lungs and kidneys. They were present in much greater numbers in an infection induced by sporozoites than in an infection induced by simple inoculation of infected corpuscles[3]. A feature of these exoerythrocytic parasites was their great refractoriness to drugs such as quinine and atebrin,

and it was suggested that such forms might be present in human malaria and constitute the explanation of why relapses so frequently occur. Clearly, this suggestion made the problem of exoerythrocytic forms of the greatest possible importance.

The work of James and Tate has been confirmed many times, and in addition exoerythrocytic forms have since been described in other malarial parasites of birds; for example, in *Plasmodium circumflexum*[7] and in *Plasmodium cathemerium*[3,6]. Sometimes these forms have been found only if the infection in the bird has been induced by sporozoites, although it has been claimed[7] that they are present in *Plasmodium circumflexum* infections if these have been induced by inoculation of parasitized cells (for a full review of the position, see Porter and Huff[8]). Experiments in these laboratories indicate, however, that the exoerythrocytic forms described by different workers in different species, and in different stages of the disease in the same species, are not all analogous stages in the life-history of the malarial parasite, and that, in fact, the only feature they may have in common is that they do not occur in red blood cells. Because of the War these experiments cannot be described in detail, but it is felt that the conclusions which they have suggested should be published because they help to clarify the problem of exoerythrocytic schizogony. The conclusions are:

(*a*) When sporozoites are introduced into the blood stream they do not persist there for more than a short time (a matter of minutes in the case of sporozoites of *Plasmodium gallinaceum*), but quickly penetrate the tissues.

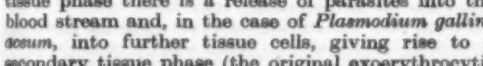
(*b*) Within the tissues they pass through a developmental phase. The duration of this 'primary tissue phase' constitutes the incubation period of the infection or, more strictly, the prepatent period. Recently, the name cryptozoites has been given to the parasites of the primary tissue phase[3].

(*c*) Following the end of the developmental primary tissue phase there is a release of parasites into the blood stream and, in the case of *Plasmodium gallinaceum*, into further tissue cells, giving rise to a secondary tissue phase (the original exoerythrocytic stage of James and Tate).

(*d*) The primary tissue phase is essentially developmental and only follows the introduction of sporozoites; the secondary tissue phase of *Plasmodium gallinaceum* may be formed from the primary tissue phase or it may be initiated by blood parasites. Unlike the primary tissue phase the secondary tissue phase is capable of indefinite schizogony, and may persist as long as an infection lasts.

(*e*) The primary tissue phase and the secondary tissue phase react differently to certain drugs.

In diagrammatic form these conclusions can be illustrated as follows:



It seems to us that the primary tissue phase is probably common to all malarial parasites, but so far the secondary tissue phase has been described definitely only in the case of *Plasmodium gallinaceum* and, if the term exoerythrocytic is used literally, in the case of *Plasmodium elongatum*, but probably, also, in the case of *Plasmodium circumflexum* and *Plasmodium cathemerium*. The secondary tissue phases of *Plasmodium elongatum* and *Plasmodium gallinaceum* are quite different from one another, and it might well be that this phase is a specialized feature of only a few malarial parasites, taking a different form in the different species—its great development in *Plasmodium gallinaceum* is certainly specialized. It remains an urgent problem to determine whether a secondary tissue phase exists in any of the species causing human malaria, because in it lies an answer to the problem of relapses.

The conclusions have their bearing on the problems of malarial chemotherapy. It will be clear that there might be as many as five forms of a malarial parasite which react specifically to drugs, namely, the sporozoite, the primary tissue phase, the secondary tissue phase, the schizonts of the red blood cells and the gametocytes. A true causal prophylactic drug will act either on the sporozoites or on the primary tissue phase, but a drug which suppresses the blood phase as it arises from the primary tissue phase will simulate causal prophylactic action which, we think, is what Mepacrine (atebrin) sometimes does when it is taken prophylactically; at least we have no evidence that it kills sporozoites, and we know that it does not kill the primary tissue phase in bird malaria.

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Manganese Hunger in Animals

WHILE engaged in an investigation, under the auspices of the Indian Research Fund Association, on the role of manganese in the synthesis of ascorbic acid by animals, an interesting observation has been made.

Rabbits were kept on a synthetic diet of purified ingredients and suitably supplemented to make it complete in the known factors except ascorbic acid. The salt mixture given was a modified salt mixture No. 185 of McCollum and Davies. When the animals were housed together in cages provided with galvanized screen bottoms, they were found, after a time, to pluck one another's fur and eat it. They also went greedily after whatever came their way by chance such as wood, cork, etc. The controls, supplemented with manganese, did not exhibit any such unusual behaviour. Rats kept on similar manganese-free diet also showed, in contrast to controls supplemented with manganese, a hankering for wood, cork, thread, etc., whenever they could get at them. They also licked the metal of the cages. When kept on this diet for a long period, they ceased to grow normally and eventually the experimental animals started dying out. Post-mortem examination revealed hæmorrhages of the lungs, liver and the intestinal capillaries. Once, when one animal out of a group of four died, the survivors ate the viscera of the dead one.

The plucking and eating of one another's fur by the rabbits, the eating of the dead animal's viscera by the surviving rats and the hankering of the manganese-deprived animals for any titbits seem to have been due to the lack of manganese in the diet.

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Oct. 19.

Chalk Brood Attacking a Wild Bee

A PIECE of partly decayed deal tunnelled by an insect received for identification in September from Acton, London, was found to contain the nest of a leaf-cutting bee, probably a Megachile sp. The wood had been split for firewood and only one cell of a series in the tunnel remained intact. The cells were formed by lining the tunnel with pieces cut from hawthorn leaves and contained a dead pupa and a food store consisting of a pellet of pollen massed together with honey. The pollen proved to be that of a composite with spiny grains 35–42 μ in diameter comparable in size and ornamentation with those of the creeping thistle, *Cirsium arvense* Scop. The purity of the pollen store suggests that this wild bee confines its attention to one species of plant at a time, a habit regarded as characteristic of the honey bee. The pupa and pollen store were invested with a white mycelium in which small black fruiting bodies were observed. On examination the fungus proved to be *Pericystis apis* Maassen, the pathogen responsible for the chalk brood disease of the honey bee. We are not aware of earlier records of this fungus attacking wild bees, though this may not be due to a scarcity of the fungus but to the infrequency with which such material comes under the notice of a mycologist.

RONALD MELVILLE.

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H. A. DADE.

Imperial Mycological Institute,
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The So-called Plücker's Plane

ONE is accustomed to see 'Plücker's plane' explained as an effect of a magnetic field on particles which, supposedly paramagnetic, arrange themselves somewhat as iron filings would.

I have observed, however, that the effect is wholly explained by the ordinary magnetic deflexion of the slow-speed cathode rays, which, issuing normally from the cathode and projecting secondary ions beyond their own range, cause, with a cylindrical cathode, the familiar cylindrical negative glow. In fields of 200–300 gausses or more, a substantially regular 'plane' appears, because all particles not originally travelling along the lines of force (that is, in 'Plücker's plane') are dissipated by the strong magnetic deflexion; but in weaker fields, of 100 gausses or less, the process of magnetic deflexion from the other parts of the cylindrical glow is very evident—in opposite directions on the two sides of the 'plane'—and this explanation is further shown to be correct by asymmetrical displacement if the poles are inclined. The more intense spots of light near the poles, if these are conical, are due to spiralling concentration along the lines of force. Again, the 'plane' is unaffected by a change from knife-edge to extensive plane poles, although in the latter case the field is uniform throughout the tube. If two poles near one another are brought to one side of the tube, so as to give the greatest possible field gradient, there results a dark space opposite the gap, due to deflexion away from there, whereas 'magnetic' particles would fill this space more densely than in the absence of the field.

If the 'ions' have any paramagnetism, it is not apparent under these various conditions. The 'hoariness' of the fallacious view of this nearly century-old experiment is remarkable, seeing that it requires the supposition of some novel kind of intensely magnetic ion formed near the cathode.

A. L. PARSON.

Hill Croft, Allonby,
Maryport, Cumberland.
Dec. 9.

Metallic Searchlight Mirrors

IN my Parsons Memorial Lecture delivered before the Physical Society on October 15, 1943, and published in NATURE of December 10, I said that "Metal searchlight mirrors, though occasionally revived, are now almost obsolete, at any rate in Great Britain, owing to the inferiority of reflecting power and the difficulty of maintaining it good under service conditions"; this statement was in accordance with what I had been able to find in print, and with what I had been able to learn personally concerning military searchlights. A certain type of metallic mirror had, in fact, been recently discarded from the service.

I now learn from Messrs Clarke, Chapman and Co., Ltd., of Gateshead-on-Tyne, that after spending a large sum on development, they have been able to overcome the difficulties, and are making metallic mirrors which are able to stand service conditions.

I knew nothing of this at the time of writing and regret not having made fuller inquiries before undertaking to say anything about the subject.

It is hoped that this letter may correct any harm that has been done.

RAYLEIGH.

Terling Place,
Chelmsford.
Jan. 6.

J. B. Hannay and the Artificial Production of Diamonds

WITH regard to Dr. Travers' letter in NATURE of December 18, p. 726, Mr. Hannay and my father were partners in some of his industrial developments. Some time after the diamond experiments were made, I remember attempts to piece together certain fragments under the microscope. I understood that Mr. Hannay was concerned lest some practical joker had interfered with the experiments as had been suggested. He, himself, was not the type of man to fake a result. He was certainly interested to check that no one else had.

JAMES WEIR FRENCH.

Barr and Stroud, Limited,
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RESEARCH ITEMS

Tent Caterpillar in India

K. A. Rahman and A. N. Kalra have described the life-history of the tent caterpillar (*Malacosoma indica* Wlk.) in the Simla Hills (*Proc. Indian Acad. Sci.*, 18, Sect. B, No. 2; 1943). The egg masses, resembling those of the notorious tent caterpillar of America, were found deposited on branches and twigs of a number of apple, and a few pear, trees, during the course of an entomological survey of the orchards in the Kotgarh ilaqa (Simla Hills) in July–August 1940. The eggs hatched out in the laboratory at Kotgarh were kept under observation, and in due course the adults were identified as *Malacosoma indica*. The pest has been recorded from apple, pear, apricot, walnut, *shaigal* (Pyrus sp.) and *ban* (*Quercus incona*), the apple suffering most severely and occasionally the pear. The pest hibernates in the egg stage, the females laying eggs as broad bands around branches of the plant, each band covered by a protective layer of dark brown gluey substance. When buds appear (about the middle of March) the eggs hatch out. The egg-stage lasts for about nine or ten months. The larvæ live gregariously, and soon after hatching spin a silken nest or tent in a sheltered place on the plant. As the larvæ grow the tent increases, finally reaching a length of 1–1¼ ft. There may be eighteen to twenty-five tents on each plant. The larvæ live in the tent by day and eat the leaves of the plant at night. When fully fed, the larvæ spin silken cocoons in protected places and pupate. The duration of life is from thirty-nine to sixty-eight days. There is only one generation in a year, the moths emerging in May and June, the duration of the total life-cycle being about a year. The entire plant may be stripped bare of leaves, only the ribs and harder veins remaining, and such plants bear no fruit. In the absence of leaves the young caterpillars may eat the tender bark.

Researches on Indian Myxosporidia

M. CHAKRAVARTY has described twelve species of Myxosporidia parasitizing fishes ("Studies on Myxosporidia from the Common Food Fishes of Bengal", *Proc. Indian Acad. Sci.*, 18, Sect. B, No. 2; 1943). Eight of these are new species and the remainder are little known in India. Most of the fishes studied were collected from local tanks or purchased from Calcutta markets. Some were kept in large aquaria in the laboratory. Most of these parasites were in the gall bladder, but one of them, *Myxobolus clarii* n.sp., was also found in the liver, testes, ovary and fat bodies, and two, *Myxobolus catlæ* n.sp. and *Thelohanellus rohitæ* (Southwell and Prasad), in the gills. Infection experiments of the fingerlings of those fishes acting as hosts for *Myxobolus catlæ* proved fatal under laboratory conditions. The parasites, particularly the spores, were mainly observed in the fresh condition, different reagents being used for special purposes.

Free Border of Intestinal Cells

A LITTLE more than a hundred years ago Henle described a free border, *freie oberfläche*, in the intestinal cells of vertebrates. Since then, owing to its obvious importance from the point of view of absorption, it has been studied by a number of authors and received a variety of names according to the interpretation of its striated appearance as seen in section. Two major conflicting interpretations have been set forth; in one it is considered to be composed of cilia or rods, and in the other the striation is supposed to result from the presence of pores or canals. The latest investigation of this interesting topic by means of most careful and modern technique is that by John R. Baker (*Quart. J. Micro. Sci.*, 84; 1942). He is a supporter of the pore theory and considers that the free border in Tetrapoda consists of a layer next to the lumen of the intestine perforated by a number of pores, a thicker layer traversed by canals at right angles to the surface and communicating with the pores, and lastly a granular layer which lies next to the cytoplasm of the cell. The suggestion is put forward that unhydrolysed fats pass through the canals in extremely fine droplets.

Nemertean Worm of the Genus Gorgonorhynchus

IN 1930 W. J. Dakin discovered a new type of Nemertean worm in Australia which he placed in a new genus, Gorgonorhynchus, and reported it in NATURE (128, 796; 1931). While typically heteronemertean in all other respects, it differs from all other members of the group in having a much branched proboscis instead of an unbranched one. In 1931 Dakin received material from India which showed it to be present there also. The following year Dr. F. J. G. Wheeler, without any knowledge of these discoveries, collected it in the Bermudas, and he has now published a discussion on its possible bearing on evolutionary theory (*Amer. Nat.*, 1943). The author points out that it was found in these three widely separated regions at about the same time but was previously unnoticed in any of them. Moreover it is common, found intertidally at all times of the year and is large enough not to escape detection by shore collectors. Marine zoologists had collected in the same areas previously, and in the Bermudas particularly two experts on the Nemerteans, Verrill and Coe, had collected intensively on the same beaches where it is now common. Dispersal may account for its appearance in India and Australia but can scarcely be held to explain its turning up in Bermuda within such a short time. The author suggests, as a possibility, an almost simultaneous gene mutation in closely related members of a group of Heteronemerteans.

Studies of Hydracarina

IN two recent publications, O. Lundblad has made noteworthy contributions to our knowledge of the Hydracarina. One (*Arkiv. Zool.*, 24; 1942) treats of those from Madeira, and the other (*Kungl. Svenska Vetensk.*, 20; 1943) those belonging to the genus Koenikea *sens. lat.* from Brazil. Both are fully illustrated by text figures and by plates containing numerous reproductions of photographs, many of them of types or allotypes. From Madeira 25 species are described and of these 24 are new or, if previously reported in brief by the author, are here more fully described with their nymphs. In spite of this large number of endemic forms only one genus, Maderomegapus, is so far peculiar to the island, and indeed all the other genera have been recorded from Great Britain. The genus Koenikea is one of the richest in species of all the South American genera and is represented by 49 species and 13 varieties, whereas in North America only 6 species of it are known. 71 species and varieties are dealt with in the text, and appended to it are a

key to the 11 subgenera of Koenikea found in South America and another key to the American species of the genus.

Studies of Bryozoa

In two recent publications from Brazil (*Bol. Faculd. Filos. Cien. e Letr. Zoologia*, No. 5, 1941 and No. 6, 1942) E. Marcus has described a number of points in the structure and development of a whole range of Bryozoa including Entoprocta, Ectoprocta and Phylactolæmata. The papers are illustrated with 22 plates and both plates and text are unusually well produced; fortunately also for many readers each paper is provided with an adequate summary in English. While the work is mainly concerned with structural and developmental features, it does nevertheless bring out a number of points that are useful from the systematic aspect. In the earlier paper the author describes in detail the life-history of *Nosema bryozoides*, a microsporidian parasite of the Bryozoa, here occurring as *Stolea evelina*.

Noise Measurements in Vacuum Tubes

In long-distance transmission systems, there must always be an adequate margin between signal and noise. Noise introduced at the point where the signal level is at its lowest—that is, at the input to each amplifier—will limit the permissible line attenuation and hence the length of line between repeater stations. Close control of tube noise is therefore of importance in keeping down the cost of the system without sacrificing telephone quality. Noise output of an amplifier the input circuit of which is a pure resistance is the sum of the effects of thermal noise in the input resistance and of tube noise. If the amplifier had a perfectly quiet tube in its first stage, the noise measured by a meter in the output circuit would be due to the thermal noise. Replacing the quiet tube by an average tube would increase the power output of the amplifier by an amount due to tube noise. Several measuring sets for determining tube noise have been devised on this principle. A new one, described in an article by J. J. DeBuske (*Bell Lab. Rec.*, 21, No. 12; August 1943), was set up to meet the need for a fast and simple method of measuring, under actual operating conditions, the noise contributed by a tube in the first stage of the line amplifier in *K*1 carrier systems. The 135-ohm input termination is connected to the input circuit of amplifier No. 1, which is the *K*1 carrier line type. This input circuit consists essentially of a transformer with impedance ratio of 135 : 30,000 and a 30,000 ohm termination on the high side which is connected to the grid of the tube under test. An attenuator, a filter, a second amplifier and a calibrated thermocouple meter, which serves as a power-measuring device, complete the equipment.

Dimethyl Ether Compound with Boron Trifluoride

Considerable interest is attached to the compound formed from dimethyl ether and boron trifluoride in which presumably a co-ordinate (or donor-acceptor) link between the boron and oxygen is present $(CH_3)_2O \rightarrow BCl_3$. The structure of the molecule has now been investigated by the electron diffraction method (S. H. Bauer, G. R. Finlay and A. W. Laubengayer, *J. Amer. Chem. Soc.*, 65, 889; 1943). The boron valency angles are tetrahedral, the distances are B—F 1·41 ±0·02 A., B—O 1·52 ±0·06 A. The ether part remains essentially unaffected: at most, the C—O separation is increased from 1·42 to 1·44 A. It is probable, but not certain, that the oxygen valency angles are tetrahedral. The conclusion reached from energy considerations is that the bond formed between boron and oxygen is due to an electron pair rather than to dipole-dipole interaction.

Partition of Energy among the Stars of the Galaxy

The results of an important statistical study of stars of different spectral types are summarized by Vyssotsky and Williams in the current *Astrophysical Journal* (98, 185; 1943), and are discussed by them in a paper which follows (p. 187). The basis of the work is a spectral classification of 7,600 stars in 441 sample regions distributed fairly uniformly over two thirds of the sky. The plates were taken on the 10-in. prismatic camera of the Leander McCormick Observatory, and the counts are complete down to photovisual magnitude 11·5. The data are discussed from the point of view of galactic concentration, and it is plainly shown that for stars at the same distance the dwarfs cluster much more closely to the galactic plane than do the giants. A surprisingly close representation of the curves connecting observed star density with galactic latitude can be obtained by assuming equipartition of energy among the stars of the main sequence. The much smaller apparent concentrations of stars of the giant branch are consistent with larger kinetic energies; *K*-type giants, for example, have velocities perpendicular to the galactic plane which are twice as big as those of the *A*-type stars. This evidence strengthens that already obtained from a recent McCormick investigation in which the mean kinetic energy of dwarf *M* stars, selected without regard to their proper motions, was found to be equal to that of the *A* stars. Evidently the Galaxy in our vicinity must be regarded as an imperfect mixture of two kinetic systems, in one at least of which (the main-sequence stars, or dwarfs) equipartition of energy prevails.

Origin of the Zodiacal Light

A new theory of the zodiacal light is given in a paper by V. G. Fessenkoff (*Astro. J. Soviet Union*, 19, No. 4; 1942) summarized in the current issue of the *Astrophysical Journal* (98, 129; 1943). That the light is sunlight scattered by small dust particles is now common ground; the problem consists in accounting for the existence in the solar neighbourhood of an oblate cloud of cosmic dust of density decreasing somewhat more rapidly than the inverse distance from the sun. The new hypothesis is that this matter arises from collisions between sporadic meteors and the asteroids. It is known that planets and satellites devoid of an atmosphere are subjected to a meteoritic bombardment which is probably responsible for their observed surface layers of pulverized rocks. The small asteroids suffer the same bombardment, but their gravitational attraction is not enough to retain the resulting dust particles; and since their total surface is enormously greater than that of a major planet, the process of dust production must be especially efficient in the asteroid zone. Fessenkoff finds that a dust cloud produced in this way will form an oblate spheroid, with the sun at its centre, surrounded by a dense ring of particles in the asteroid zone. The former is responsible for the conical zodiacal light; the latter for the uniform zodiacal band visible along the entire ecliptic throughout the night.

NITROGEN LOSS FROM SOILS AND OXIDE SURFACES

By PROF. N. R. DHAR and DR. N. N. PANT
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IT has been reported[1] that when a virgin soil is brought under cultivation, the percentage of total nitrogen usually falls off with time up to a limiting value. A loss of nitrogen from soils on the addition of nitrogenous compounds, especially when the conditions are favourable for oxidation, has also been observed by different investigators; but this phenomenon has been explained satisfactorily by Dhar and collaborators[2], who have postulated that this type of nitrogen loss in soils is chiefly due to the formation and decomposition of the unstable ammonium nitrite produced in the processes of ammonification and nitrification. There is also the possibility of the reaction of nitrous acid on amines, amides and amino-acids which may sometimes be present in the soil or formed in the decomposition of soil organic substances. It has also been reported that soil loses nitrogen in the form of nitrogen gas much less when manured with sodium or potassium nitrate than when treated with ammonium sulphate, urea or other organic nitrogenous manures.

It has been shown in a number of papers that this phenomenon of denitrification is accelerated by light and by the presence of acids, and markedly retarded by carbonaceous substances like sugar, molasses, cellulose, etc. The loss of nitrogen is enhanced by increase of temperature, and at the same temperature this loss is much greater in sunlight than in the dark. From our experiments on the processes of ammonification and nitrification of different nitrogenous compounds in presence of sterile and unsterile soils and with photo-active surfaces like titanium oxide, zinc oxide and iron oxide (Fe_2O_3), it has been concluded that the amounts ammonified and nitrified and the loss of total nitrogen are much greater in light than in the dark in both sterile and unsterile conditions, and the phenomena of ammonification and nitrification can take place in the complete absence of micro-organisms.

In order to establish that the phenomenon of denitrification can be a non-bacterial process, careful experiments under completely sterile condition have recently been carried out. 2 gm. urea and 2 gm. gelatine are first autoclaved in the dry condition in a number of boiling tubes for 10 minutes at 15 lb. pressure. These substances were added under aseptic condition separately to 600 c.c. Pyrex glass flasks, some containing 100 gm. sterilized soil with 100 c.c. autoclaved distilled water, and others containing only sterilized oxides (1 gm. titanium oxide and 0·1 gm. zinc oxide) with 50 c.c. autoclaved distilled water. To one set of these flasks, previously sterilized, glucose was added, and finally all the flasks are sterilized by steaming for more than twenty minutes. One set of flasks was covered with black cloth to cut off light and the other set exposed to sunlight for 8 hours every day. In order to eliminate the temperature effect, the dark set was also placed in sunlight. The exposure continued for 650 hours. At the end of the exposure, all the sets were tested and found free from any bacterial contamination. The contents of the flasks were analysed for total carbon and nitrogen at the end of the exposure, after adding a few drops of dilute sulphuric acid to prevent loss of ammonia during analysis. The following results were obtained:

TABLE 1. EXPERIMENTAL FLASKS UNCOVERED IN SUNLIGHT.
Total nitrogen introduced in soil sets = 289·3 mgm. in oxide sets = 249·6 mgm. nitrogen.

	Total carbon introduced (gm.)	Total carbon unoxidized (gm.)	Total carbon oxidized (gm.)	Total nitrogen (mgm.)	Total loss (mgm.)
	per cent	per cent	per cent	per cent	per cent
(1) Soil+gelatine +0 gm. glucose	1·0294	0·9467	0·0827	251·10	38·20
(2) Soil+gelatine + 1 gm. glucose	1·4294	1·2389	0·1905	278·50	10·80
(3) Soil+gelatine + 3 gm. glucose	2·2294	1·9371	0·2923	284·70	4·60
(4) Soil+gelatine + 5 gm. glucose	3·0294	2·6807	0·3487	284·70	4·60
(5) Oxides+gelatine + 0 gm. glucose	0·6172	0·5598	0·0574	229·80	19·80
(6) Oxides+gelatine + 1 gm. glucose	1·0172	0·9060	0·1112	240·90	8·7

TABLE 2. EXPERIMENTAL FLASKS COVERED.

	Total carbon introduced (gm.)	Total carbon unoxidized (gm.)	Total carbon oxidized (gm.)	Total nitrogen (mgm.)	Total nitrogen loss (mgm.)
	per cent	per cent	per cent	per cent	per cent
(1) Soil+gelatine + 0 gm. glucose	1·0294	0·9866	0·0428	273·60	13·70
(2) Soil+gelatine + 1 gm. glucose	1·4294	1·2982	0·1312	284·50	4·80
(3) Soil+gelatine + 3 gm. glucose	2·2294	2·0189	0·2105	286·70	2·60
(4) Soil+gelatine + 5 gm. glucose	3·0294	2·7712	0·2582	286·80	2·50
(5) Oxides+gelatine + 0 gm. glucose	0·6172	0·5780	0·0392	243·80	5·80
(6) Oxides+gelatine + 1 gm. glucose	1·0172	0·9575	0·0597	246·20	3·40

TABLE 3. EXPERIMENTAL FLASKS UNCOVERED IN SUNLIGHT.
Total nitrogen introduced in soil sets = 974·6 mgm.; in oxide sets = 933·4 mgm.

	Total carbon introduced (gm.)	Total carbon unoxidized (gm.)	Total carbon oxidized (gm.)	Total nitrogen (mgm.)	Total nitrogen loss (mgm.)
	per cent	per cent	per cent	per cent	per cent
(1) Soil+urea + 0 gm. glucose	0·8842	0·7410	0·1432	907·40	67·20
(2) Soil+urea + 1 gm. glucose	1·2842	1·0634	0·2208	951·10	23·50
(3) Soil+urea + 3 gm. glucose	2·0842	1·7576	0·3266	967·40	7·20
(4) Soil+urea + 5 gm. glucose	2·8842	2·5217	0·3625	969·20	5·40
(5) Oxides+urea + 0 gm. glucose	0·40	0·3062	0·0938	900·70	32·70
(6) Oxides+urea + 1 gm. glucose	0·80	0·6435	0·1565	920·20	13·20

TABLE 4. EXPERIMENTAL FLASK COVERED.

	Total nitrogen introduced (gm.)	Total nitrogen unoxidized (gm.)	Total nitrogen oxidized (gm.)	Total nitrogen (mgm.)	Total nitrogen loss (mgm.)
	per cent	per cent	per cent	per cent	per cent
(1) Soil+urea + 0 gm. glucose	0·8842	0·7977	0·0865	953·20	21·40
(2) Soil+urea + 1 gm. glucose	1·2842	1·1094	0·1748	966·30	8·30
(3) Soil+urea + 3 gm. glucose	2·0542	1·8417	0·2425	969·00	5·60
(4) Soil+urea + 5 gm. glucose	2·8842	2·6030	0·2812	971·40	3·20
(5) Oxides+urea + 0 gm. glucose	0·40	0·3498	0·0502	922·60	10·8
(4) Oxides+urea +1 gm. glucose	0·80	0·6982	0·1018	927·70	5·7

From the foregoing results it is clear that nitrogen is lost both in soil and with oxide surfaces on the decomposition of urea and gelatine, even in the complete absence of micro-organisms. The loss of nitrogen is greater in light than in the dark. No doubt the denitrification is much less with the oxide surfaces than with the soil, but the surface offered by the oxide is much less than that presented by the soil. Moreover, the addition of glucose markedly reduces the amount of denitrification of urea and gelatine in the light as well as in the dark. These results confirm that non-biological denitrification is possible and that light accelerates the process in a marked manner.

[6] Compare Lipman and Blair, *Soil Sci.*, **12**, 1 (1921); Russell and Richards, *J. Agric. Sci.*, **8**, 495 (1917); Russell, "Soil Conditions and Plant Growth", pp. 377–378 (1937).

[8] NATURE, **134**, 572 (1934); *J. Indian Chem. Soc.*, **12**, 67, 77, 756 (1935); **13**, 555 (1936); **15**, 543, 583 (1938); *Proc. Nat. Inst. Sci., India*, **7**, 115 (1941).

AGRICULTURAL EDUCATION ASSOCIATION CONFERENCE

THE half-yearly meeting of the Agricultural Education Association, which was held during January 4–5 at the London School of Hygiene and Tropical Medicine, concerned itself partly with problems of a direct educational interest, and partly with matters of a more technical nature.

A considerable amount of time was devoted to a consideration of the agricultural education of the youth of fifteen and older, a very topical subject in view of the impending changes in the educational scheme of the nation. Mr. A. S. McWilliam, acting headmaster of Lady Manners School, Bakewell, started the discussion with an account of the agricultural 'bias' which has been imparted to the teaching of boys and girls over fourteen years of age in his school. After a good general education in the earlier years, the child is given the choice of grouped subjects, but biology is a compulsory subject for both boys and girls. The biology is divided into three sections, plant biology, animal biology and soil science. The teaching is made as experimental as possible, and agricultural plants, etc., are used as examples. Bees, a demonstration orchard and school clubs form an important part of the system.

Mr. McWilliam said that the bias was introduced in 1920 with the object of making the science course more attractive, improving the examination results, and encouraging the parents to leave their children longer at the school. The object is not to teach boys and girls farming, but to make use of the country way of life in teaching the principles of science. At the same time it was hoped to create in the minds of the children a better understanding of the importance of the fertility of the soil, the biology of the mammal and the principles of nutrition. Both the laboratory and outside work are arranged on the heuristic system whereby the child is allowed to discover some elementary facts by itself.

Dealing with the objection raised in some quarters that the teaching of agricultural science in the secondary schools will not give an adequate grounding in science for the student who enters an agricultural college or university, Mr. McWilliam said that at Lady Manners School this has not been found to be the case. Boys and girls have gone forward to the universities and colleges and have been as successful as those from other schools. He is convinced that the agricultural bias in the secondary school after the age of fourteen creates a wider outlook, a greater interest in school work and a better understanding of the countryside. But if the schools are to encourage boys and girls to take up agricultural careers, they must be assured of a decent livelihood in circumstances where the amenities are equal to those of the town; to attain this we must have a prosperous countryside able to pay good wages and offer good prospects to the best boys and girls.

Mr. J. Hunter Smith, principal of the Hertfordshire Farm Institute, in speaking of the farm institute as an introduction to adult education, not only gave a detailed educational programme but also strongly stressed the need for non-vocational or cultural subjects in the curriculum. He advocated the establishment of Young People's Colleges in rural districts, equipped with appropriate workshops, where the part-time student could get further education through hand and eye rather than by lecture and book. At the farm institutes he hopes that there will be a new approach to technical instruction by linking it more intimately with living or moving examples and activities, for there is something dead and uninspiring in transcribing notes on breeds of livestock, varieties of cereals and all the dry data that are so frequently provided. He wants the principle of farm management to be absorbed rather than taught, through continual field observation and the study of records.

In Mr. Hunter Smith's opinion, it is extremely important that non-vocational subjects should find a definite and prominent place in the syllabus of every farm institute. It is a mistake to relegate this basic branch of adult education to occasional debates, discussions or special lectures in the evening. The first lecture hour in the morning would be the ideal. That hour would represent just a little of the idea which has borne such bountiful fruit in the Danish high school.

With regard to the demand for training in agriculture that will arise when the Services are demobilized, Mr. Hunter Smith suggested that the first step should be a period of some months up to a full year as a 'working guest' on a suitable farm. Thus by work on the land, and especially by fireside talks in the farm-house, these men would learn what it all means in respect of both work and prospects.

The first of the technical papers to be read was contributed by Dr. John Hammond, on "The Breeding of Cattle for Milk or Meat". He pointed out that the supremacy of British farmers in methods of breeding for beef is based on visual judgment and touch of the animal. These methods are of little use in the breeding of cattle for milk and butter-fat yields, unless they are coupled with complete production records extending over a number of generations. This is probably the reason why we have not attained that supremacy in breeding for milk that we have in beef production. A great extension of milk recording is still required. Unfortunately, milking qualities cannot be measured directly in the bull, and since each year he may contribute thirty-five calves or more to the next generation while the cow produces rather less than one, the importance of paying attention to the bull when breeding for milk is obvious. Dr. Hammond advocated a system of breeding from "proven" bulls similar to that which has given such striking results in Holland, the United States and Denmark in recent years in breeding for milk and butter-fat.

Dr. Hammond is of opinion that we can obtain

only a small proportion of our beef from pure beef herds; the bulk of our beef must be obtained from dual-purpose cattle or from these crossed with a beef bull. To obviate the danger that heifers from this cross may find their way into dairy herds and so reduce the efficiency of the dairy industry, he advised the use of beef bulls having a distinctive colour marking, such as the Hereford (white face) or Aberdeen Angus (black colour), which are dominant genetic characters and so colour-mark their offspring with a trade mark for beef.

A plan for the organization of machinery instruction within the county education framework was outlined by Mr. D. I. McLaren, who contended that the facilities available for obtaining advice on agricultural engineering problems have not kept pace with those provided for the other branches of the industry. Among other recommendations he suggested the inauguration of an advisory service, partly within the county under the charge of a suitably trained man with the status of assistant county agricultural organizer, and partly on a provincial basis, with an adviser in agricultural engineering on the lines of the existing advisers in chemistry, economics, etc.

Mr. C. Davies put in a plea for the reduction of types and varieties of farm machines on the grounds that many of them are not really necessary. He said that the War has taught us to do without many things in ordinary life which were previously considered necessities, and many tools which formerly were considered useless unless of a very exact shape are unobtainable to-day; but we shall find that other shapes do just as well and sometimes even better. In the case of the plough, of which very many types exist, he said that the demands for a particular shape or type are often due, not to a profound knowledge of what the soil requires, but to local custom or prejudice. The same holds good for other farm implements and machinery. Mr. Davies said that it is not in the farmer's own interest to ask for an unnecessary variety of implements, because the fewer the number of different shapes and types a manufacturer has to turn out the lower the costs, and the lower the charge to the farmer. The farmer of the future will have to be more machine-minded, remarked Mr. Davies; no factory can afford to abuse the mechanical equipment it has installed to the same extent as happens on so many farms, and continue to pay dividends. In the discussion on this paper, it was pointed out that the farmer is not entirely to blame in failing to protect his machinery from the weather; the great shortage of suitable farm buildings puts him in a very difficult position, especially now that new construction is limited because of shortage of materials.

IMPROVEMENT OF LIVESTOCK

PROF. ROBERT RAE, of the University of Reading, contributed a valuable address on the improvement of livestock to the proceedings of the National Veterinary Medical Association of Great Britain and Ireland (*Vet. Rec.*, **55**, 429; 1943).

During the War, he said, millions of acres of land have been ploughed up and there have been tremendous increases in crops which can be consumed directly, such as potatoes, barley, wheat, sugar beet and so on. Before the War Great Britain imported ten million tons or so of feeding stuffs for farm animals at a cost of about fifty million pounds a year. Producers of pigs, poultry and milk were most dependent on this, sheep farmers were least so. As the War decreased the shipping available for these imports, first priority in imported foodstuffs was given to dairy cows and milk production, while pigs and poultry came last, because they are almost entirely dependent on the concentrated foods which are largely imported. At the present moment the numbers of our dairy cows have been maintained, with a small increase, but beef cattle and sheep have been reduced to some extent. At the same time our large livestock population has built up reserves of soil fertility which has helped our crop production.

Prof. Rae thinks that livestock production must remain after the War the predominant feature of British agriculture. We shall need fresh (perishable) agricultural products; large areas of Great Britain are not suitable for intensive arable cultivation, although much of this land can be improved; even in our arable areas there is much land which cannot without the fertilizing power of livestock upon it, be kept in what the farmer so graphically and beautifully calls 'good heart'. Prof. Rae does not advocate the return of large areas to permanent grass. He thinks that the war-time policy of temporary pastures, endorsed by generations of Scottish farming, should be continued after the War. They give fresh, clean pastures and should give increased stock-carrying capacity and the opportunity of using the fertility accumulated by the livestock. This system of temporary leys has been introduced by the County War Agricultural Committees much more quickly than it could have been introduced in normal times.

Prof. Rae thinks, however, that we do not produce enough food for even our pre-war numbers of livestock. We ought to revert to our pre-War numbers of livestock or to increase them, and, if we do, we shall need imported foods again after the War. Further, Great Britain has often been called the stud farm of the world. The best herds and flocks of many other countries, of the Dominions Overseas and of North and South America were founded on stock supplied by Great Britain, and our pre-War trade in breeding stock was valuable. We could, indeed, be proud of our breeding stock; but we could not be satisfied with a good deal of our ordinary stock in the fields. The level of all livestock in Great Britain needs to be raised; more farmers should attempt the difficult job of breeding. More breeders and fewer mere multipliers of stock is, in Prof. Rae's opinion, a sound maxim for the future.

The rest of his address develops this theme by interesting and valuable summary and comment upon some of the schemes which seek, at present, to improve dairy cattle and pigs in Great Britain. How many people, one wonders, when they get their loaves and bacon and bottles of milk, are aware of the vast organization, the immense labours of mind and muscle and the complex organization and machinery which combine to deliver them at their doors? More than one book has been written about the marvellous organization which delivers at our doors the daily newspaper; and marvellous that organization is: but how much greater, how beneficent and how poorly appreciated are the miracles daily done on the English farm.

Among contributors to the instructive discussion which followed this address were Colonel E. M. Curley, chief veterinarian, European Theatre of Operations, United States Army, and Dr. Tj. Bakker, who gave interesting accounts of some aspects of veterinary work in the United States and Holland.

FORTHCOMING EVENTS

*(Meetings marked with an asterisk * are open to the public)*

Saturday, January 22

BIOCHEMICAL SOCIETY (at the British Postgraduate Medical School, Ducane Road, Shepherds Bush, London, W.12), at 11.15 a.m.

INSTITUTE OF PHYSICS (ELECTRONICS GROUP) (joint meeting with the MIDLAND BRANCH of the INSTITUTE OF PHYSICS) (at the University, Edmund Street, Birmingham), at 2.30 p.m.—Discussion on "Space-Charge and Noise in Radio Valves" (to be opened by Dr. P. B. Moon and Dr. R. R. Nimmo).

Monday, January 24

ROYAL GEOGRAPHICAL SOCIETY (at Kensington Gore, London, S.W.7), at 5 p.m.—"The British Arctic Air-Route Expedition, 1930–31"; Geographical Films with Commentary by Members of the Expedition.

INSTITUTION OF ELECTRICAL ENGINEERS (at Savoy Place, Victoria Embankment, London, W.C.2), at 5.30 p.m.—Discussion on "Industrial Applications of Radio-Frequency Methods of Heating" (to be opened by Mr. N. R. Bligh).

Tuesday, January 25

ROYAL ANTHROPOLOGICAL INSTITUTE (at 21 Bedford Square, London, W.C.1), at 1.30 p.m.—Miss Olive Lodge: "Folk Festivals in Jugoslavia".

INSTITUTION OF BRITISH AGRICULTURAL ENGINEERS (at the Royal Society of Arts, John Adam Street, Adelphi, London, W.C.2), at 1.45 p.m.—Prof. D. B. Johnstone-Wallace: "Mechanisation of the Family Farm".

ROYAL SOCIETY OF MEDICINE (at 1 Wimpole Street, London, W.1), at 4.15 p.m.—Dr. Donald Hunter: "The Clinical Approach to Industrial Medicine".

INSTITUTION OF CIVIL ENGINEERS (at Great George Street, Westminster, London, S.W.1), at 5 p.m.—Mr. H. D. Morgan: "Wharves on Soft Foundations".

ROYAL INSTITUTION (at 21 Albemarle Street, London, W.1), at 5.15 p.m.—Prof. H. D. Kay: "Modern Developments in Dairy Science", 1. "Milk and Milk Products as Foods".*

Wednesday, January 26

ROYAL SOCIETY OF ARTS (at John Adam Street, Adelphi, London, W.C.2), at 1.45 p.m.—Mr. R. N. Armfelt: "Education To-day and To-morrow", 3: "Primary Schools".

PHYSICAL SOCIETY (COLOUR GROUP) (in the Physics Department of the Imperial College, Imperial Institute Road, London, S.W.7), at 2.30 p.m.—Dr. T. Vickerstaff: "Some Difficulties encountered in applying the Theory of McAdam's Limiting Brightness to Real Dyestuffs".

Thursday, January 27

ROYAL INSTITUTION (at 21 Albemarle Street, London, W.1), at 2.30 p.m.—Sir Lawrence Bragg, F.R.S.: "The Strategy and Tactics of Crystal Structure Analysis by X-Rays".*

ROYAL SOCIETY OF MEDICINE (at Manson House, 26 Portland Place, London, W.1), at 4 p.m.—Dr. W. Norwood East: "Criminal Responsibility and Medical Culpability".

BRITISH INSTITUTION OF RADIO ENGINEERS (at the Institution of Structural Engineers, 11 Upper Belgrave Street, London, S.W.1), at 6.30 p.m.—Mr. F. E. Lane: "Special Electron Tubes".

Friday, January 28

ROYAL INSTITUTION (at 21 Albemarle Street, London, W.1), at 5 p.m.—Sir Harold Spencer Jones, F.R.S.: "Measuring the Sun's Distance".*

INSTITUTION OF MECHANICAL ENGINEERS (at Storey's Gate, St. James's Park, London, S.W.1), at 5.30 p.m.—Prof. G. S. Baker: "Fundamentals of the Marine Screw Propeller" (Sixteenth Thomas Lowe Gray Lecture).

Saturday, January 29

ROYAL PHOTOGRAPHIC SOCIETY (SCIENTIFIC AND TECHNICAL GROUP) (at 16 Princes Gate, South Kensington, London, S.W.7), at 2.30 p.m.—Symposium on "Microdensitometry and Microsensitometry".

APPOINTMENTS VACANT

APPLICATIONS are invited for the following appointments on or before the dates mentioned:

HEADMASTER of the Junior Technical School—The Principal and Clerk to the Governing Body, Wigan and District Mining and Technical College, Wigan (January 27).

EDUCATIONAL PSYCHOLOGIST (full-time)—The Secretary for Education, Education Offices, York (January 28).

ASSISTANT MASTER to take ADVANCED MATHEMATICS as the main subject and PHYSICS as a subsidiary subject, and an ASSISTANT MASTER to take MECHANICAL AND ELECTRICAL ENGINEERING SUBJECTS—The Principal, Enfield Technical College, Queensway, Enfield, Middlesex (January 28).

SPEECH THERAPIST to serve the Crewe and Cheshire Education Committees jointly—The Director of Education, Imperial Chambers, Prince Albert Street, Crewe (January 29).

HEAD OF THE ENGINEERING MANUFACTURE AND TRADES COURSE SECTION of the Department of Mechanical Engineering—The Principal, Central Technical College, Suffolk Street, Birmingham (January 31).

HEAD OF THE MINING DEPARTMENT at the North Staffordshire Technical College, Stoke-on-Trent—The Clerk to the Governors, Education Offices, Town Hall, Hanley (January 31).

ORGANIZER OF AGRICULTURAL EDUCATION to the East Suffolk County Council Education Committee—The Secretary for Education, County Hall, Ipswich (February 1).

PRINCIPAL of the Gloucestershire College of Domestic Science and Training College—The Secretary, County Education Office, Shire Hall, Gloucester (February 5).

DEMONSTRATOR (man or woman) in the Department of Zoology—The Secretary, Bedford College for Women, Regent's Park, London, N.W.1 (February 5).

QUALIFIED ENGINEER for the development of Light Alloys, their utilization in fabricated form, the investigation of technical problems arising out of current applications and research into new applications, in the North-Western Area—The Ministry of Labour and National Service, Central (Technical and Scientific) Register, Advertising Section, Alexandra House, Kingsway, London, W.C.2 (quoting Reference No. C.1962.XA) (February 5).

HEAD MASTER—The Clerk to the Governors, Sir Joseph Williamson's Mathematical School, 116 High Street, Rochester (February 12).

UNIVERSITY LECTURER IN ANTHROPOLOGY—The Secretary of the Appointments Committee, Faculty of Archæology and Anthropology, Museum of Archæology and of Ethnology, Cambridge (April 15).

WORKS ENGINEER for Non-Ferrous Metal Producing Plant in South Wales—The Ministry of Labour and National Service, Central (Technical and Scientific) Register, Advertising Section, Alexandra House, Kingsway, London, W.C.2 (quoting Reference No. C. 1944.XA).

HYDROGRAPHICAL SURVEYORS for the Basrah Port Directorate, Iraq—The Ministry of Labour and National Service, Appointments Department, Sardinia Street, Kingsway, London, W.C.2 (quoting Reference No. O.4862.S.).

ASSISTANT PHARMACIST for the Tanganyika Territory Medical Department—The Secretary, Overseas Manpower Committee, Ministry of Labour and National Service, Alexandra House, Kingsway, London, W.C.2 (quoting Reference No. 1218).

MATHEMATICS MISTRESS (honours degree) at the English High School, Haifa—The Secretary, Jerusalem and the East Mission, 8 St. Thomas Street, Winchester.

Two full-time ASSISTANT TEACHERS for (*a*) SCIENCE and/or MATHEMATICS; and (*b*) GENERAL TECHNICAL SUBJECTS including WOODWORK or METAL WORK—The Principal, County Technical College, Stoke Park, Guildford, Surrey.

LECTURER IN MECHANICAL or ELECTRICAL ENGINEERING, and a SCIENCE LECTURER—CHEMISTRY and/or PHYSICS, with subsidiary Mathematics, at the Swansea Technical College—The Director of Education, Education Department, Guildhall, Swansea.

ASSISTANT CHEMIST and an ASSISTANT PHYSICIST—The Director of Research, Linen Industry Research Association, The Research Institute, Lambeg, Co. Antrim, Northern Ireland.

REPORTS and other PUBLICATIONS

(not included in the monthly Books Supplement)

Great Britain and Ireland

The J. and P. Scheme of Apprenticeship Training in Engineering. (Publication G.1.) Second edition. Pp. 12. (London: Johnson and Phillips, Ltd.) [2412

Proceedings of the Royal Society of Edinburgh, Section B (Biology). Vol. 62, Part 1, No. 1: On *Isoetes australis* S. Williams, a New Species from Western Australia, Part 1: General Morphology. By Dr. Samuel Williams. Pp. 8+3 plates. 9*d*. Vol. 62, Part 1, No. 2: Hidden Divergence in Laboratory Strains of *Drosophila pseudo-obscura*. By Rowena Lamy. Pp. 9–19. 1*s*. Vol. 62, Part 1, No. 3: Genotypic Asymmetries. By Dr. Gunnar Dahlberg. Pp. 20–31. 1*s*. (Edinburgh and London: Oliver and Boyd.) [2412

Colonial Research Committee. Progress Report, 1942–1943. (Cmd. 6486.) Pp. 26. (London: H.M. Stationery Office.) 6*d*. net. [2812

Ministry of Health: Emergency Medical Services. Memorandum No. 6: The Organisation of a Hospital Rehabilitation Department. Pp. 10. (London: H.M. Stationery Office.) 2*d*. net. [3112

Geological Survey of Great Britain: Scotland. Wartime Pamphlet No. 36: Peat Deposits of Scotland, Part 1: General Account. By Dr. G. K. Fraser. Pp. 55. (London: Geological Survey and Museum.) 2*s*. 6*d*. [41

Other Countries

Sudan Government. Wellcome Chemical Laboratories: Sudan Medical Service, Khartoum. Report of the Government Analyst for the Year 1942. Pp. 16. (Khartoum: Wellcome Chemical Laboratories.) [2412

Smithsonian Institution: United States National Museum. Bulletin 183: Archeological Investigations in Platte and Clay Counties, Missouri. By Waldo R. Wedel; with Appendix: Skeletal Remains from Platte and Clay Counties, Missouri, by T. Dale Stewart. Pp. viii+284+50 plates. (Washington, D.C.: Government Printing Office.) 1 dollar. [2412

Annual Report of the Board of Regents of the Smithsonian Institution, showing the Operations, Expenditures and Condition of the Institution for the Year ended June 30, 1942. (Publication 3705.) Pp. xiii+421+83 plates. (Washington, D.C.: Government Printing Office.) 1.50 dollars. [2412

Commonwealth of Australia: Council for Scientific and Industrial Research. Bulletin No. 164: Studies in the Biology of the Skin and Fleece of Sheep. 1: The Development and General Histology of the Follicle Group in the Skin of the Merino; 2: The Use of the Tanned Sheepskin in the Study of Follicle Population Density; 3: Notes on the Arrangement, Nomenclature and Variation of Skin Folds and Wrinkles in the Merino. By H. B. Carter. Pp. 60+16 plates. Bulletin No. 166: Fertility in Sheep; an Experimental Study of Periodicity of Oestrus and Non-breeding Seasons in Australia. By Dr. R. B. Kelley and H. E. B. Shaw. Pp. 24. (Melbourne: Government Printer.)